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VOL. XVII.—No. 406.

THE BRITISH ASSOCIATION MEETING.

JUST a year has sped since the scientific world and its associates were agitated with the prospect of a novel experience in their pursuit of knowledge and enjoyment—a trip across the wide Atlantic; and now again the votaries of all that is, to the outside million, mysterious and wonderful, their appetite for holiday pleasures in connection with the more serious business of scientific discussion whetted by the remembrance of last year's ample realisation of roseate expectations, are exercising their minds in similar manner as to the amount of physical and mental profit they can acquire in the short period bounded by the first and last days of the coming fortnight. The meetings connected with the great annual gathering of the British Association, which this year is to take place at Aberdeen, are to extend only from Wednesday next week till Thursday in that following; but taking into consideration that this comprises so great a portion of the two weeks as to leave only a day or two at beginning and end, and considering also the remoteness of the *venue* for the majority, as we may assume, of those who will assist in the proceedings, it will scarcely be incorrect to say that a whole fortnight will be devoted to the great assemblage arranged for what may be termed "scientific recreation."

The visit to Montreal last year, we are told, imparted an impetus to the association, the effects of which are felt in arranging for this year's meeting, a much larger number, compared with English meetings of the last few years, signifying their intention of being in attendance at Aberdeen. Those who carry out their determination will have scant cause for regret, for, as it seems to us, provision of the most excellent and extensive character has been made for their comfort and amusement during their stay in the interesting old town, and the allotted time, it is not difficult to predict, will hurry by all too quickly. What with the sectional meetings in the middle of the day, excursions, garden parties and other entertainments in the afternoon, lectures, conversaziones, &c., in the evening, little time will be left each day for brooding over disappointed hopes, or for otherwise cultivating *ennui*. Then, besides these, there are art galleries, schools of art, manufactories of many kinds, and local objects and places of interest—not a few—to be visited; and, in fact, the most hypochondriac of mortals should find the wherewithal to enjoy himself, or be branded with the stigma of ingrate to the end of his days.

Whatever may be said as to the absence of any benefit to science from the annual reunion of the members of the British Association, we think it is highly desirable that these gatherings should take place. There may be no direct gain, but nothing is lost by keeping the world aware of what is being accomplished in the region of science; and the more general and comprehensive the character of the papers and discussions at the various meetings the better, as this the more easily enables a grasp to be obtained by those who, while possessing an enduring interest in scientific pursuits, are yet not specialists, of the progress made in science as a whole. Purely technical or special papers should be reserved for the meetings of the various learned societies, and the proceedings of the British Association should, in our view, be carried out on the broadest lines in order to achieve the best results.

THE REIS TELEPHONES.

THE *Scientific American* has an able article on telephone matters, which, as it will probably interest a large number of our readers, we reproduce. Our contemporary says:—

"It is a well received principle in patent law that an invention is protected for all possible uses, even for such as were unforeseen by the inventor. In some of the voluminous testimony and arguments of the Bell telephone suits, it has been suggested that the transmission of articulate speech was not contemplated in the original Bell telephone patent. Yet under the law such a feature would not invalidate the patent, which would be good for all its uses.

"The same state of things exists in the case of the old Reis telephone. Philipp Reis invented, constructed, and experimented with a number of different kinds of telephones during a period extending from 1859 to 1874. He died in 1874. Precisely in accordance with modern telephone practice, he divided his instruments into two classes, transmitters and receivers. These instruments have been repeatedly tried of late years, and it has been definitely determined that they will transmit articulate speech. It would seem, therefore, that in them would be found the complete anticipation of Bell's broad claim to the electrical transmission of speech. But the point is made that in Reis's hands his instruments did not effect this. It is argued that they were only designed to transmit sounds in general, such as the tune of an air sung into the receiver, or the notes of a piano or other musical instrument. The analogy between the position of the 1876 Bell patent and the Reis telephones is perfect. In both instruments is latent the capacity for transmitting speech, but by neither Bell nor Reis was this power distinctly claimed.

"In view of the really striking analogy the anticipation seems most complete. Both inventors appear on the field with devices adapted for the same end, but neither with perfect distinctness claims this function as a part of the invention.

"The courts in their sweeping decisions in favour of the Bell patent dispose very summarily of Reis's inventions. In one decision the judge rather gratuitously says that a century of Reis would not have produced an operative telephone. By all the decisions, Bell's claims have become so broadly construed that the actual Reis telephone could not be used without infringing them, if it were so used as to transmit speech. In other words, if one of our readers were to place a Reis transmitter in one house and a Reis receiver in another, and connect them by wire, and were to talk over such a line, he would constitute himself an infringer of Bell's claims, though he was using an invention made by a man who died two years before the date of Bell's 1876 patent. If Reis himself, as is almost certain, spoke through his telephones, he ought to be considered an infringer in advance of his time.

Seriously speaking, however, the bearing of the Reis inventions upon the Bell claims depends on the following facts:—Reis's telephones did transmit sound; they probably transmitted speech in the days of the inventor, as they are perfectly capable of doing so at the present time. This much should constitute them an anticpation of the broad claim to electrical transmission of speech. But their effectiveness as anticipations would be vastly increased if it could be definitely proved that speech had been transmitted by them during Reis's lifetime.

"Numerous passages from Reis's writings are cited to prove this. But they all are considered unsatisfactory to about such an extent as is the Bell patent of 1876, in its own claims to speech transmission. An appeal to Reis's contemporaries has been made with far more fruitful results. In Prof. S. P. Thompson's work on the Reis telephone, a number of letters from friends of Reis are printed. Many of the writers are men in high standing in the scientific world. The letters are in some cases to the effect that articulate speech was received through the telephones as early as 1859–1864. Others are not so definite as to the facts. But the general unanimity of all on this subject is most striking. They effectually disprove of the 'century of Reis' theory, so firmly upheld by one of the circuit judges.

"The fact is that the scope of the Bell patents as determined by the courts is a monument to the ability of the lawyers engaged by the Bell Telephone Company. So thin a series of claims were in all probability never before made to protect a monopoly so securely. We are firm believers in according protection to inventors. The recent tendency of the courts to destroy patents should certainly be deprecated by all who have the real interest of the country at heart. But, in equal measure, the unjust broadening of claims should be condemned by all. A monopoly of an extent measured by one hundred millions of dollars should not be sustained on any but a solid basis. The inventor, Mr. Bell, has reaped ample reward for any merit that did exist in his labours. As his work seems to have been so largely anticipated, and as the public are really suffering from the rigid monopoly awarded his stock company, it is time his claims were more carefully scrutinised and their extent limited. This work we hope will be effectually done by the Supreme Court, whenever the case will be properly presented to them.

"The general opinion of patent lawyers is that the United States Supreme Court has been too rigid in its dealings with original patents and reissues. Few patents, comparatively, can stand before it. The Bell patents have not yet reached this last tribunal. When they do, some restriction will certainly be placed upon them. It will not be strange if the much criticised action of the court in patent cases shall at last be productive of good, and tend to defining and restricting the extent of a monopoly that has become a public evil. The morals of the case and justice to the inventor have been amply satisfied. It now is only a question of how to deal with the members of a giant corporation. On the one hand is the comparatively limited number of stockholders, on the other hand is the public at large. The inventor and his family have all reaped fortunes out of the patent. The corporation itself has founded a business that the entire annihilation of the patents would not destroy. Thus even in the destruction of the Bell patents no hardship would be done, and the public would be vastly benefitted."

Submarine Cables.—So much interest is centred in the electric light and the telephone that the columns of technical journals, devoted to the propagation of electrical science, but rarely contain matters relating to other branches of the same subject. It is a relief to readers and to those who cater for their requirements, to occasionally note something out of the usual path, and we think that this will be found in an article on defective submarine cables on page 210.

ELECTRICAL TRANSMISSION FROM NIAGARA.*

By BENJAMIN RHODES, M.Am.Soc.C.E.

A remark commonly attributed to Sir William Thomson has been frequently and variously quoted, the substance being that the water power of Niagara could be utilised by transmitting it electrically to great distances.

A recent number of an electrical journal † says that "little or no profit can be derived from the production of electric light (presumably by steam power), at a price per unit below that of illuminating gas."

Dynamic electricity is used at present substantially only for the electric light, but this use has become a great and growing industry; therefore, if there is any truth in the statement that electric light cannot be profitably produced by steam power, then Sir William Thomson's transmission scheme becomes of vast importance. It is the object of this paper to show what has been done and what may be done toward the utilisation of Niagara for electrical purposes.

Power of Niagara.—The power of Niagara can be estimated very approximately. The average flow of the river, according to the many careful measurements of the U. S. Lake Survey, is 275,000 cubic feet per second. The fall in the river through the rapids immediately

above the Falls is ... ... 65 feet.
Height of the Falls ... ... 165 „

Total ... ... 230 „

Then we have for the whole power:

$$\frac{275{,}000 \times 230 \times 62}{550} = 7{,}000{,}000 \text{ H.P.}$$

(Seven million horse-power.)

To utilise this amount of power by water wheels, generate electrical currents and transmit to various cities within 500 miles, would necessitate a plant representing at least five thousand million dollars. Such figures as these give some idea of the enormous amount of power here in reserve.

Power already developed.—A small proportion of the power of Niagara is already utilised, and a much larger amount can be developed at a moderate cost. On the Canada side the entire use is represented by a small overshot wheel, under 6 feet head, which has for many years propelled a solid piston single acting pump, furnishing a meagre supply of water to the adjoining village.

On the American side, along the rapids, on Goat Island, and the mainland, there are five separate raceways, using 4 to 16 feet head, and developing in all 800 to 1,000 horse-power, most of which is now in actual use. If the project for the appropriation of lands for a State reservation at Niagara is carried out, all these races will come within the fixed bounds of the park, and will, of course, be odious in the eyes of the Commissioners, and be swept away.

The greatest power now in use at Niagara, however, fortunately lies outside of the proposed State Park. The Hydraulic Canal is a work of great importance. It was constructed about 1855, and is cut through solid rock across the peninsula on which the village of Niagara Falls is built, taking the water from the extreme head of the rapids and discharging below the Falls, giving opportunity to use the entire head of 230 feet. The lower end of the canal is at such a distance from the Falls that the "busy roar and hum" of the factories will be quite unheard by the romantic visitors, who see only beauty, not utility, in the great cataract. The canal is nearly one mile long, and was planned 100 feet wide and 10 feet deep. It has been excavated but 70 feet, and half the distance only 35 feet wide, and is at present partially filled with debris, being at certain points no more than 5 feet in depth. At the lower end is a basin nearly at right angles to the canal, which may be extended, as needed, along the river frontage belonging to the Hydraulic Power Company. The canal lay idle for a quarter of a century, and it remained for an enterprising citizen of Buffalo, possessed of large capital as well as zeal, to open up the great power to the world. At the time of his purchase, in 1878, there was only one water wheel on the canal. There is now a large and increasing number of buildings for manufacturing purposes distributed along the high bank of the river, using an aggregate of nearly or quite 5,000 horse-power. The wheels in these buildings are set under heads of from 50 to 100 feet, and discharge the tail water over the side of the precipice, the various streams falling over 100 feet to the river below, making a sight of rare beauty, but suggestive to the engineer of great loss of power. Some of these wheels are of large size when the head is considered, several being capable of giving 1,100 to 1,500 horse-power each. The use of wheels of so great power was a step in advance of anything previously attempted in this line, and, as in all cases where there is lack of experience, difficulties were met. Without going into detail, it will suffice to say that fragments of water wheels may be found in the vicinity of all the wheel pits where high heads are used, and that water wheel manufacturers seem to be learning a lesson long ago taught to bridge builders—to use no cast iron. The last few years have seen great improvements in the making and setting of wheels, and the working of all the mills is now regular and continuous.

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* From the Transactions of the American Society of Civil Engineers, June 10th, 1884.

† The *Electrician*, New York, May, 1884.

Further development of power at Niagara may be largely made at a moderate expense. The Hydraulic Canal can be deepened and widened to keep pace with demand for power, and with further experience wheels may be set under greater heads; the total amount thus made available here being equal to the necessities of many years. It may safely be said that the use of Niagara has just begun. Low water is unknown, troubles from ice are slight, hours of use are not limited to 8 or 10, but 24 hours in the day and 365 days in the year unlimited power is ready, making this the most reliable as it is the grandest water power in the world.

Application to Electricity.—The application of the water power of Niagara to electrical purposes has been limited, being hitherto confined to the local use of the electric light; but this use has been such as to give much valuable experience.

A Brush dynamo has been in use in Prospect Park for the illumination of the Falls and grounds since July 4th, 1869. This machine is run under peculiarly favourable conditions, having always the same number of lamps in circuit, power supplied by a water wheel of proper capacity, and the plant operated only two hours of each day. The working has always been smooth.

A Weston dynamo, with a service lamp and reflector, was for some time used to light the beautiful rapids in the rear of the Cataract House. Some difficulty was found with this plant, not, however, due to the power.

Several isolated Edison installations have been made in various mills, the dynamo in each case being run by the water wheel which furnishes power for the mill. While the power is continuous, the light is excellent, the only difficuly with such a plant being that in case of shutting down for repairs auxiliary power must be supplied for the dynamo, or other light used.

A local Brush company was organised in the fall of 1881, and has since been lighting the streets and dwellings of the village with 40 to 60 lamps. The company has met with not only the usual difficulties of such organisations, due to inexperience and the sudden introduction into general use of new machinery and unfamiliar principles, but, in addition, other troubles, due to the interruption in the power from various causes, so that a steam plant has been maintained by the side of the water wheel. As heretofore noted, the improvement in power has been marked, and it is probable that the steam plant will be used hereafter only in such extraordinary emergency as might be classed with the bursting of a steam boiler or the destruction of a building by fire. Experience has shown the immense difference in cost between the use of steam and water power. Electric street lights are furnished profitably at a price much lower than at any other place, and if the number were greater the price could be still further reduced.

The future application of Niagara's power to electrical purposes is an interesting subject. The local use will keep pace with the growth of the town, but will, of course, be comparatively small. In order to transmit currents of electricity profitably to a distance, several conditions must be observed.

1st. The cost of transmission must be less than the difference between the cost of steam and water power.

2nd. The distant point must be one where the currents of electricity can be used; and

3rd. Where water power cannot be obtained.

There is no point so likely to fulfill these conditions as the city of Buffalo, and the project must be proven practicable here before being attempted to larger and more distant cities. The estimates following are based upon the Brush system, not on account of any merit in this beyond other systems, but because it happens to be here in most general use.

There are in this city 400 arc lights, requiring the use of steam plant of about the same number of horse-power. The number of lights is increasing here, as in other cities, and it may be assumed that there will be 1,000 lights in use within two years. The length of circuit required between Niagara Falls and Buffalo is about 50 miles. There are now in operation in various cities circuits 10 to 12 miles in length, and Sunday nights, when fewer lights are used, circuits are used in some cases to a length of 30 miles. Estimates are therefore based on practice as well as theory. Experience has shown that 40 to 60 lights can be run on one circuit with an electromotive force of 2,000 to 3,000 volts; but a greater number requires a current of so great intensity as to be in some danger of burning the insulation on the dynamos, as at present constructed. There is no doubt the dynamos will be hereafter improved in this respect, so as to permit 100 arc lights in circuit. Such an improvement will very materially reduce the cost of transmission to great distances. As the resistance of the circuit and consequent loss of power varies directly as the length, and inversely as the area of the wire used, there will be found for every case a size of wire such that the sum of its cost and the capitalised loss of power will be reduced to a minimum. The size of wire will be less for water power than for steam, and the economical size for a transmitting circuit of (say) 50 miles between Niagara Falls and Buffalo is found to be No. 8, B.W.G., or $\frac{165}{1000}$ inch diameter. The cost of erection, complete, of a number of circuits of this length would be about $4,000 per circuit. The resistance would be 76 ohms, equal to 16 lamps, or, assuming the very general practice of coupling in series a 40-light and 16-light Brush dynamo, the loss would be about 28 per cent.

The rental of power at Niagara Falls, in large quantities, may be assumed at $10 per horse-power per annum, delivered on the shaft. The cost of transmission will be interest, repairs and depreciation, which will all be covered by 10 per cent. on the investment. The cost ($4,000) must be divided by the net number of lamps or horse-powers (40), making the cost per horse-power 10 per cent. on $100, or $10, and the entire cost per horse-power of power delivered in Buffalo, $10 + $10 = $20 per annum.

The items of cost of dynamos, carbons, lamps and care of lamps are common to the use of steam and water, and need not be considered. The most enthusiastic advocate of steam power will hardly claim that it can be produced for 10 to 12 hours a day at less than $50 per annum, and as used for electric lights, with small engines, the cost is actually nearer $75 per annum. The saving, then, may safely be assumed to be $40 per annum, or on a plant for 1,000 arc lights, the snug sum of $40,000 yearly.

The incandescent light presents another phase of this matter. It is well understood that the great quantity of current required for these lights, and the consequent percentage of loss by resistance, prevents its economical use at a distance from the dynamo, and explains the marked absence of central stations for such lighting in our cities. The use of the storage battery for this purpose may now be said to have passed the experimental stage, and has come into use to a considerable extent during the last few months. By this system the same dynamo used at night for arc lights is run during the day to charge secondary batteries to be used on incandescent circuits the succeeding night—the distance being overcome by the intensity current, which is automatically regulated when in use so as to be suitable for incandescent lamps. With steam power, the cost of running by day is the same as at night, and the system becomes expensive. With water power the reverse is the case. The charge for water power is the same for 24 hours as for 8 or 10, and the interest on plant is also a fixed charge, so that when the expense can be divided between night and day usage the figure above will be reduced to only $10 per horse-power per year and the saving be doubled.

The use of electro-motors for the reconversion of electricity into power might be touched on here, but this branch, although well advanced in theory, is not so in practice. Many good minds are occupied in perfecting electro-motors for various purposes, and another year or two may see power supplied to customers from a central station, for running anything from a sewing machine to a street car. In such case the economy of transmission will be still further apparent.

Enough, however, has been said to show that the power of Niagara can be transmitted to a distance of 25 miles, with a great saving over the power of steam, and that with improvements in storage batteries and electro-motors this distance can be increased, with economy, to 100 or 150 miles. With further improvements in dynamos and insulating material to permit the use of currents of higher intensity, such as may be confidently looked for, the economical distance may be still further increased, until some of the present generation may see the prophecy of Sir William Thomson literally fulfilled, and the power of Niagara used in all the large cities of this country.

INCANDESCENCE LIGHTS ON ARC LIGHT CIRCUITS.

In the Brush multiple series system of incandescence electric lighting, seven Swan lamps (38 volts each) are placed abreast in the arc light circuit to receive the ordinary 10 ampère (2,000 C. P.) current. Eight lamps may be used, but the total amount of light yielded is less than with seven. Six lamps may be used in each group, the light of each lamp being brighter, the power required for the group being greater, and the length of life of the lamps being thus shortened. The 10 ampère current being thus divided between seven lamps, each carbon carries 1·43 ampéres. If one lamp breaks, the remaining six carry the whole current, or about 1·66 ampères for each carbon. This increased current would increase the probability of a breakage among the six. When the second carbon is thus ruptured, each of the five remaining lamps would have to carry nearly two ampères of current. The third and all of the remaining lamps would then quickly be destroyed, thus opening the circuit.

To prevent such a result, each group of lamps is provided with a "Multiple Series Cut-out Box," which also serves as a switch for turning the lights on or off. The box is about seven inches (17·5 centimetres) in diameter. Its external appearance is shown in the accompanying illustration, fig. 1, and its construction and operation are simple, the apparatus requiring no attention after first adjustment.

In fig. 2, a and b are metal pieces, with binding posts for the reception of the terminals of the main line. A metal lever, c, is pivoted at a, and is worked by an insulated handle, e. m is an electro-magnet with a coil of high resistance, whose terminals are connected with a and b, and which is always in the circuit. (The connections are omitted in the diagram.)

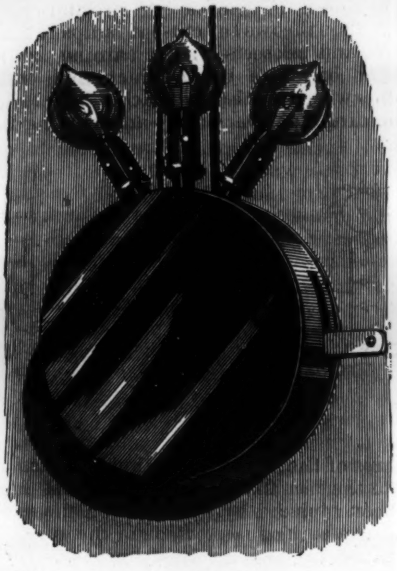

FIG. 1.

m' is a coil made of a few turns of stout copper wire, one end of which is connected with each of the incandescence lamps, 1, 2 and 3; the other end of the wire is flattened and is supported at z, just above an insulating pad resting upon i and slightly separated from the wire, running down from a.

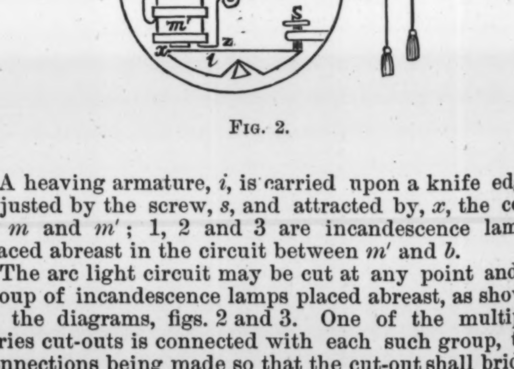

FIG. 2.

A heaving armature, i, is carried upon a knife edge, adjusted by the screw, s, and attracted by, x, the core of m and m'; 1, 2 and 3 are incandescence lamps placed abreast in the circuit between m' and b.

The arc light circuit may be cut at any point and a group of incandescence lamps placed abreast, as shown in the diagrams, figs. 2 and 3. One of the multiple series cut-outs is connected with each such group, the connections being made so that the cut-out shall bridge the group as if it were another lamp.

When the lever, c, is raised, as shown in fig. 2, all of the lamps and the cut-out are short-circuited. When the lever is pulled down the whole current passes through the group of lamps and the cut-out magnet, m—the lamps 1, 2 and 3, as well as m', being open-circuited at z.

The armature i is adjusted so that when the resistance of the group of incandescence lamps is normal (*i.e.*, when the proper number of lamps is working in the group), the current shunted through m is so small that x is unable to raise i. But if a lamp in the group be broken or removed, the greater current thus shunted through m causes the armature to rise and close the circuit at z. This throws the cut-out lamps 1, 2 and 3 into the circuit, and protects the remaining lamps of the group from breakage by the increased current that would otherwise pass through each. The coil, m', now aids in holding up the armature and keeping the circuit closed at z.

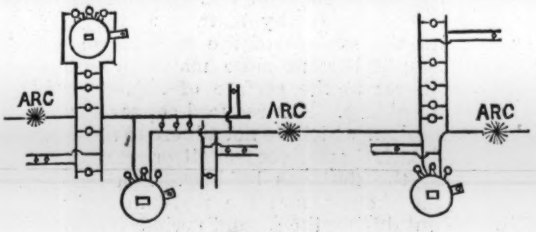

FIG. 3.

The lamps of the group being thus dimmed, attention is called to the fact that one of the lamps has broken and has been replaced by the three on the cut-out box. A sound lamp being substituted for the broken one, the cut-out lamps are open-circuited by raising the lever, c, and immediately lowering it. As soon as the lever is raised, the magnets m and m' are short-circuited and the armature falls, thus opening the circuit at z. The subsequent lowering of the lever sends the whole current through the group of lamps and the fine wire coil, m, as at first.

It is evident, writes Mr. E. M. Avery in the *Electrical World*, that each group may be turned on or off at will, but that the individual lamps of a group cannot be thus controlled. As the system is intended for stores, offices, &c., rather than for residences, and as the lights are designed for rental at a given price per group for a specified number of hours, the inability to turn out a single light is not a matter of considerable inconvenience. Of course, it is easy to arrange the circuit with three-point switches or other familiar appliances so that one lamp may be darkened and another one lighted. This may be convenient in some cases, as when a lamp is placed in a cellar and the switch at the head of the cellar staircase. In other words, it is as easy then to switch the current into another lamp as it is to switch it into a German silver helix of equal resistance, but nothing would be gained thereby, as the power required would be the same, whether the lamp were burning or not. It is apparent from the above description that no safety fuses are required, and consequently none are used.

AN ELECTRIC LIGHT SHOW ROOM.

ONE of the most interesting and extensive displays of this nature is to be seen at the establishment of Messrs. Norman & Son, at Glasgow. The object is to show in how many ways electric lighting can be treated so as to meet various requirements, more particularly with reference to its domestic use. The floor space, walls, and ceiling of a splendid show room, about 70 feet in length, are all utilised for this purpose. In a corner are two rows of E.P.S. accumulators, which are charged by a dynamo driven by a 14 H.P. steam engine located in the ground floor of an adjacent building. From these storage batteries the current can be switched on at will to the different series of lamps throughout the room. On a number of stands are shown examples of the way in which the use of incandescent lamps can be adapted to the existing fittings and decorations of a room such as gasaliers, girandoles, statuettes, vases, ornaments under glass shades, and the foliage of a conservatory. On the walls are representative brackets more or less ornamental in various materials, and also pictures, showing how an additional charm may be imparted to them by peculiar modes of lighting. The ceiling is utilised for demonstrating how rooms can be fitted up effectively and economically where the installation is to be of a temporary or experimental nature, or in cases where interference with the ceiling is to be avoided, or an unsightly roof hidden from view. A light frame work, the exact area of the ceiling or roof, is fixed an inch or two below it, and covered with paper of a suitable pattern. This forms a screen for the wires and a background from which to hang the lamps. In some cases a small coloured glass shade, fixed above the lamp, throws upon the paper above an illuminated representation of a flower in such a manner as to harmonise with the patterns. Many of the contents of this room are to be removed this week to the Mining Exhibition just opened at Glasgow. Messrs. Norman & Son are also contractors for lighting part of the exhibition building.

PRIMARY BATTERIES FOR ELECTRIC LIGHTING.*

MR. J. F. KELLY, in a letter to the *Electrical World*, says:—In your issue of August 1st appeared a short account of some tests being made on primary batteries in Boston. I quote: "On July 7th, at 12 M., a battery of nine cells was started at lighting two 8 candle-power lamps, six minutes on and six minutes off, day and night, the interruptions being accomplished by the aid of an ordinary 24-hour clock. This was continued until July 20th, at 10 o'clock a.m., when the lamps had been burning a total of 152 hours. The object of this arrangement was to get the 152 hours inside of 12 days, while in practice they would be spread over six weeks." A little further on we find that "the inventors, Messrs. Kauffer and Goldner, state that the work put upon the battery in the test described was harder than it would have been if running according to their original claim; four hours a day for a period of 38 days."

It is well that the inventors have told us this. Certainly no one in the light of the above account would imagine it to be true were he not told. It is seemingly as absurd as to say that because a diamond carbon or Leclanché battery will work, one minute closed and one minute open, for, say, two hours without apparent deterioration, that it is a good practical battery for work in which it must be used one hour continuously; in other words, a battery that will work well on open circuit will work well on closed circuit. Indeed, according to Messrs. Kauffer and Goldner, it will work better in the latter case.

The point that I wish to bring out is that these Boston tests are such as might be, very appropriately, applied to open circuit batteries, and that the only true way to test a battery intended to work for three or four consecutive hours is to keep it closed continuously for at least as long a time as it would be in actual practice. I venture to say that the Diamond carbon or the Leclanché battery, the cells being properly coupled, would do nearly, if not fully, all that is claimed for the Kauffer and Goldner battery. Perhaps the inventors may be able to clear up this matter. Let us have light.

NEW REFLECTING GALVANOMETERS.

FOR various conditions of current to be detected or measured, it is frequently desirable to alter the astatic system, and to substitute for the coil or coils temporarily employed another or others of greater or less resistance. Further, it is necessary that the coils should be removed or inserted as expeditiously and readily as possible, and that they should be easily and readily accessible. Their framework, moreover, should oppose no obstacle to the operation of hanging the suspended system, and should be so put as not to endanger the integrity of the latter by accidental closing during adjustment.

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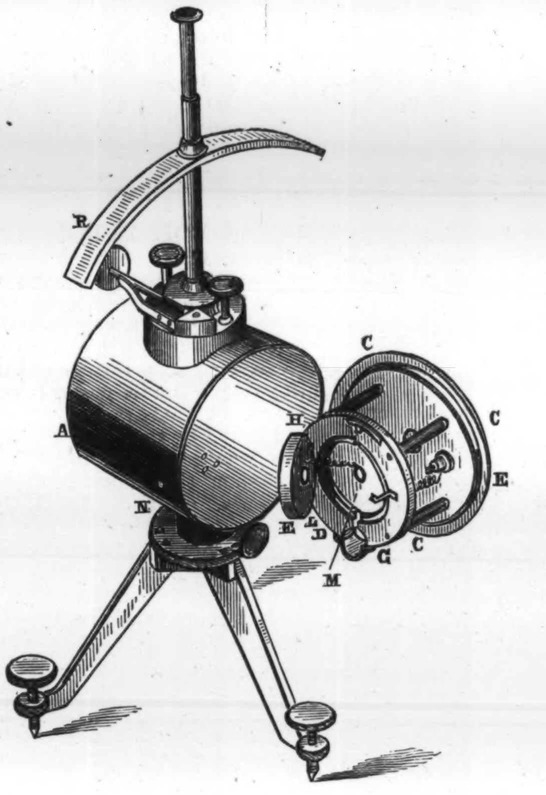
* See also ELECTRICAL REVIEW for August 22nd.

Mr. Robert J. Pratt, of Troy, has provided means for fulfilling these conditions. The accompanying cut, reproduced from the *Operator*, represents the general construction, showing that the coils and suspended system are attached to and supported by the back plate, B, which is hinged to the main casing, A, and adapted to be secured in position by a catch, N. The front ring, E, is hinged to the framework, D, below the horizontal diameter of the latter, so that it can be dropped down to one side, disclosing the suspended system. The peculiar position of the hinge prevents the ring from closing accidentally during the operation of adjusting the system. Another important feature of the galvanometer is that the coils are so located in the rings that they are adjustably removable. The galvanometer has been patented and made by the Electric Manufacturing Company, of Troy, N.Y., from whom further information may be obtained.



THE ELECTRICAL PROTECTION OF DEFECTIVE CABLES.

WHEN there is in a telegraph cable a partial earth, which is not so serious as to prevent the stations from corresponding with one another, we may avoid costly repairs, whose success is often uncertain (writes M. P. Bayol in *Annales Telegraphiques*), or we may at least defer as long as possible the moment at which those repairs become unavoidable, by using a *system of electrical protection*, which prevents the leakage from increasing, and even, to a certain extent, causes it to decrease.

The different systems of electrical protection in use are based on the electrolytical action which the currents sent into the cable exert on the medium which surrounds the conductor laid bare at the faulty point.

Action of the Different Currents on the Fault.—Generally speaking, we may say that the positive current oxidises the surface of the copper where it is bare, attracting towards it the electro-negative elements of the surrounding medium, such as oxygen, chlorine, &c., and causes thus the formation of a layer of electrolytical deposits, which offers resistance, and the leakage consequently becomes less.

The negative current, attracting towards the bare copper the electro-positive elements of the medium, such as hydrogen, sodium, &c., reduces, in the first place, the resisting earthy matters which may be in contact with the surface of the conductor; secondly, the hydrogen, finding no more matter to reduce, is set free and adheres to the surface of the copper, finally escaping in bubbles. The reduced copper forms scales of a brown colour which do not adhere to the conductor, but either detach themselves from it, or are mechanically removed by the first gas bubbles. During the first period of the phenomenon the resistance of the fault decreases, but during the second period that resistance increases in consequence of the formation of gas bubbles which adhere to the copper. The resistance may become considerable if the hydrogen gas cannot escape on account of the narrowness of the fissure in the dielectric. In the opposite case a state of affairs will be established, presenting periods more or less regular, in accordance with the manner in which the escape of the gas bubbles takes place.

The decrease of the resistance of the fault, which is the first effect of the negative current, can also be observed with the positive current if the latter should have to oxidise any hydrogen deposited by a previous negative current. The resistance will in that case continue to decrease until all the hydrogen has disappeared and the current commences to act on the copper.

It will be seen that *the final effect* of both currents is *the increase of the resistance of the fault.* Moreover, as the earthy or gaseous deposits cover the copper, an electromotive force due to polarisation is set up, which produces a current that opposes the primary current on the first section of the line but strengthens that same current on the second section. This electromotive force of polarisation of the fault may be considered as placed in derivation on the fault, producing a current which opposes the polarising current.

Secondary chemical actions, greatly modifying the result of the electrical action, may occur between the deposits formed on the conductor and the substance of the dielectric.

We must add, that, during the periods of rest, the hydrogen accumulated on the copper by the negative current is rapidly diffused through the surrounding medium, which circumstance causes the resistance of the fault to fall.

The double current system of transmission which on long cables is the only system possible, in consequence of the phenomena produced by the residual charge, is, in this case, the least advantageous on account of its injurious action on the fault. A succession of alternate currents results, indeed, in the total rupture of the conductor at the fault, each positive current oxidising a portion of the conductor, which is again deoxidised by the succeeding negative current. The rupture of the conductor is then merely a question of time, dependent on the strength of the current.

Classification of the Systems of Protection.—The foregoing examination throws sufficient light on the following classification of the different systems of protection adopted.

FIRST CLASS.—Sealing up the fault by sending into the cable positive currents of suitable strength.

This class is divided into two categories, namely:—

First Category.—Positive currents sent at variable periods when the insulation falls below a certain limit. *Example*—The cable in the Lake of Geneva.

Second Category.—Positive currents sent regularly and automatically whilst the cable is working, so as to restore at each moment the insulation which has a tendency to fall. *Example*—The Calais-Fanö cable.

SECOND CLASS.—Sending a permanent positive current which maintains a permanent positive potential at the fault, notwithstanding the fluctations of the working current. *Example*—The French Brest-St. Pierre Miquelon cable (the Pouyer-Quertier cable).

The first class of systems, which is suitable for gutta-percha cables immersed in fresh water, such as the cables in the Lake of Geneva, would be fatal to submarine cables protected by the same dielectric; for the positive current acting on the salt water would form copper oxychloride which eats away the gutta-percha. The result is quite different when the dielectric consists of caoutchouc, as in the case of the Calais-Fanö cable.

The best solution of the problem is that furnished by the systems of the second class, which oppose in an absolute manner the wasting away of the copper due to the use of alternate currents. The negative current which passes constantly through the leak, actually enlarges it at first, but afterwards the fault can no longer increase. It even happens that the oxygen bubbles stop the leak by forming around the conductor, as it were, a preserving gaseous sheath.

The System of Protection for the Pouyer-Quertier Cable.—A fault has existed in the French cable from Brest to St. Pierre Miquelon (the Pouyer-Quertier cable) ever since it was laid. This fault is situate in about the middle of the Atlantic; it is, however, not sufficiently serious to stop the telegraphic communication; it has merely called into existence the following system of protection intended to prevent the loss from becoming greater.

A permanent current is sent into the cable of sufficient strength to decompose the sea water at the fault and to maintain a negative potential at that point in spite of the fluctuations of the working current. Under the present conditions the potential of the protecting current at the fault is maintained at about 3 Daniell's.

The protecting current is furnished by a battery of 50 Minotto cells established at the Brest office. The positive pole of that battery is connected to the earth, and its negative pole is joined to the cable beyond the apparatus of the office, through a resistance of 100,000 Siemens units.

As the cable is separated from the apparatus at Brest and from that at St. Pierre by condensers, and as the protecting current is almost constant, that current can in no way interfere with the formation of the signals.

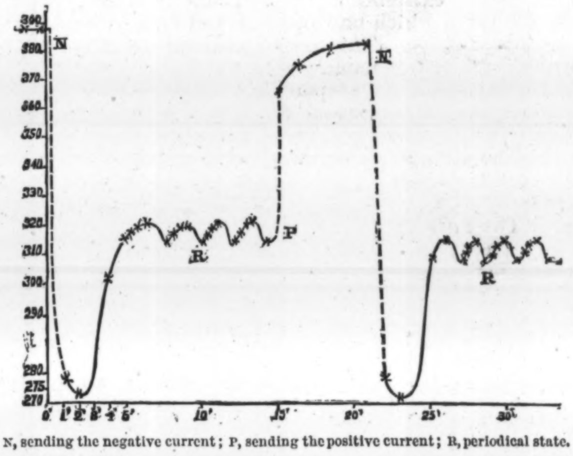
In order to determine the number of cells required for the protecting battery, the potential at the fault must be measured by means of an electrometer fixed at St. Pierre. The result of this measurement is transmitted to Brest, which office accordingly regulates the strength of the protecting battery.

The System of Protection for the Danish Cable.—The Danish cable from Calais to Fanö, which forms a section of the line from Paris to Fredericia, has a fault, which manifested itself five or six years ago, at a distance of 4 kilometres from the landing place of the Hutes-d'Oye, near Calais.

At that point the cable is deeply buried under the sands which accumulate at that part of the coast, and it would be very difficult to replace the defective part. However, the fault, although being somewhat serious, does not stop the telegraphic communication. The cable continues working, and the moment of effecting the repairs is to be put off as long as possible by maintaining the exposed part of the conductor oxidised by the action of the positive current. In order to effect this the line battery is composed of two groups, one positive the other negative, of different electromotive forces, the positive group being the stronger of the two. Thus at the cable station at Calais the relay, which is actuated by the current from Paris, and which must translate that current over the cable, is served to that effect by two batteries—one, the negative battery of 10 Fuller's bichromate cells, and the other, the positive of 20 Fuller's cells. As the dielectric of the cable consists of caoutchouc (Hooper's compound), the copper oxychloride which is formed has not the injurious effect which it would have if the dielectric consisted of gutta percha. But that copper oxychloride does not adhere to the conductor. If we study the action of a positive current on a fault immersed in a vessel containing sea water, we see, indeed, that the oxychloride is diffused through the liquid under the form of long, whitish filaments, which have a tendency to settle down very slowly. The action of the positive current does not then appear to be so efficient as would be imagined. In any case the succession of alternate currents must use up the copper, as the negative currents reduce a portion of the deposits formed by the positive currents, the rupture of the conductor is sure to be the ultimate result. It will be seen that the system adopted by the Danish engineers is not so effective as that applied by Varley for the protection of the Pouyer-Quertier cable.

The above remarks on the variation of the resistance of the faults under the influence of the action of the different currents are the results of numerous experiments which I have made, and of which the following example will give an idea.

Having placed in a vessel filled with sea water a section of submarine cable 50,600 metres long and of 286 ohms resistance, I immersed one of its extremities, after having bared it for a length of about 1 centimetre. The other end I connected to an ordinary Wheatstone bridge, which served me to measure the total resistance of the line and that of the fault. I then went on to modify the resistance in order to maintain the balance, following step by step the variations of the resistance measured at the different stages of the experiment.

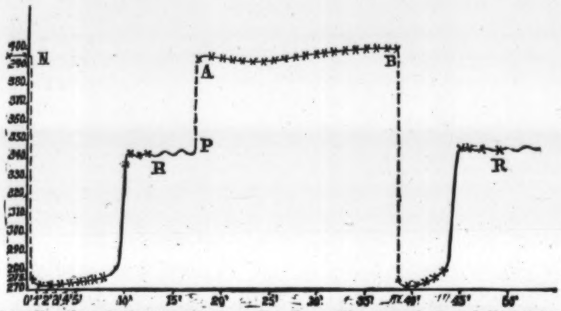


N, sending the negative current; P, sending the positive current; R, periodical state.

FIG. 1.

The curve in fig. 1 shows the resistance obtained under those conditions with a test battery of 10 Callaud cells. The resistance having been first increased to 388 ohms by the action of the positive current, I sent a negative current, and obtained, after a lapse of one minute, a first balance of 275 ohms (a lower figure than the normal resistance of the line, which is, as stated, 286 ohms). I then observed a gradual decrease of the resistance which fell, after the lapse of two minutes, to a minimum of 272 ohms. Beyond that point the resistance increased more and more rapidly. I could at first maintain the balance by successively unplugging resistances of 1, 2, 3, 4, 5, and 10 ohms; but afterwards the variations became too rapid to be followed; at the fourth minute I obtained a balance of 310 ohms. Finally, after the lapse of five minutes, the resistance remained steady at 325 ohms. Soon after the periodical state set in, which was very easy to follow by means of the rheostat. During each period, which lasted about two minutes, the resistance increased slowly and very regularly from 224 to 229 ohms, and then fell suddenly to 224 ohms.

One minute after the reversal of the test current I obtained a balance of 375 ohms. I observed then a regular increase to a maximum of 388 ohms. This maximum was nearly reached after seven minutes of positive electrification. Reversing, then, the current again, the same series of phenomena was reproduced.



N, sending the negative current ; P, sending the positive current; R, periodical state.

FIG. 2.

The curve in fig. 2, constructed under the same circumstances, after having modified the fault a little, shows a peculiar action on the part of the positive current, which manifests itself rather frequently (see the portion A, B, of the curve). That current at first slightly diminishes the resistance, and finally increases it. In this case there is, as in the case of the negative current, a minimum of resistance.

It will be seen that the resistance obtained with the positive current is always higher than that obtained with the negative current. Those differences, as well as the sudden depressions and elevations of the curve at the moment of the reversals of the test current, are due to the existence of an electromotive force, set up by the fault, which now opposes and then strengthens the test current. This electromotive force may result from three causes, namely :—

1. The difference of potential between the exposed part of the conductor and the iron sheath, which produces the "*natural current of the cable.*"

2. The variable polarisation of the exposed part of the conductor due to the electrolytic deposits which cover it.

3. The difference of potential of the earth between the place where the measuring apparatus are fixed and that where the fault is situate, which produces an earth current often very variable. In the above-mentioned experiments this last cause did not, of course, operate.

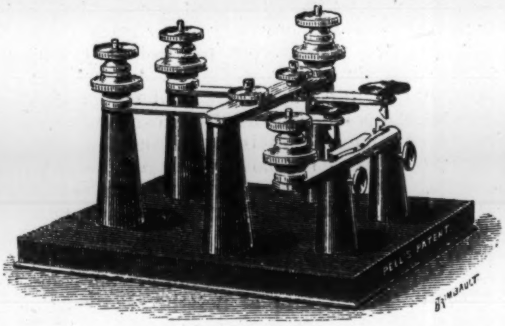
The following is the result of some experiments on the rupture of conductors by the action of alternate currents.

I employed a battery of 50 Callaud cells in series. A piece of cable of U shape was immersed in a vessel containing sea water. At the lower part of the U I removed the coverings for a length of 3—4 centimetres. One extremity of this piece of cable was insulated, and the other was connected to one pole of the battery. The circuit was closed by the iron sheath and the water contained in the vessel, without any other exterior resistance. The current was reversed every half hour.

Patterns of cable.	Description of conductor.	Total diameter of conductor.	Number of half hourly currents necessary to cause the rupture of the conductor.
1	7 strands of 5/10 mm.	17/10 mm.	4
11	7 strands of 12/10 mm.	33/10 mm.	27

PELL'S PATENT SELF-LOCKING TESTING KEYS.

IN many respects the ordinary forms of testing keys for use in cable testing, &c., leave a good deal to be desired, their mechanical construction being by no means perfect. It is often the case that such an expedient as inserting a piece of folded paper between a cam and key in order to make the latter give a firm contact, has to be resorted to, an expedient which although no doubt effective, can hardly be regarded as satisfactory. *Pell's patent self-locking key* entirely overcomes the liability to failure by dispensing with the cam altogether, and introducing a spring latch which, when the key is depressed, automatically catches and holds it with certainty in position until it is released; the movement, either in depressing the key or in releasing it being effected with one hand, a point which is by no means an unimportant one. The latch is released by pressing the ebonite knob on the insulating pillar as shown in the engraving above.



The other advantages of this key over the old form, although not of so much importance, will be appreciated by all who take a pride in the appearance of their apparatus. The absence of the cams and their supporting pillars, besides improving the insulation, and allowing of the key being more easily cleaned, makes it look neater, and prevents the lacquered surface of the brass work being disfigured, as is invariably and unavoidably the case when the cam is used.

A short-circuiting key is also made on the same principle, the spring in this case being somewhat stronger to prevent unintentional locking when the key is tapped by the finger for observing the range of the deflection on the galvanometer scale. Messrs. Johnson and Phillips are the sole makers of the new keys.

THE FIRMNESS AND DENSITY OF CARBON FILAMENTS.

(*Continued from page* 190.)

Carbon of my own production.—Fibres of Manilla hemp carbonised in their natural condition, and coated with carbon by a peculiar process. The thickness of the carbon filament of the round section $d = 0{\cdot}14$ millimetre, section of the filament $r^2 \pi = 0{\cdot}0154$ square millimetre.

$$P = 0{\cdot}360 \text{ kilo.}$$
$$0{\cdot}380 \;\;,,$$
$$\text{Mean } 0{\cdot}370 \text{ kilo.}$$
$$M = 24{\cdot}03 \frac{\text{kilo.}}{\text{square millimetre.}}$$

With a carbon filament of almost double thickness $d = 0{\cdot}24$ millimetre, $r^2 \pi = 0{\cdot}0452$ square millimetre, there resulted

$$P = 1{\cdot}625 \text{ kilo.}$$
$$0{\cdot}870 \;\;,,$$
$$1{\cdot}230 \;\;,,$$
$$0{\cdot}870 \;\;,,$$
$$\text{Mean } 1{\cdot}149 \text{ kilo.}$$
$$M = 25{\cdot}4 \frac{\text{kilo.}}{\text{square millimetre.}}$$

The result of this experiment agrees very well with the former.

Further, a carbon filament produced from twisted fibres, of 0·17 millimetres in thickness and $r^2 \pi =$ 0·0226 square millimetre section was submitted to an examination. There was found for the load

$$P = 0{\cdot}310 \text{ kilo.}$$
$$0{\cdot}405 \;\text{,,}$$
$$0{\cdot}410 \;\text{,,}$$
$$\text{Mean } 0{\cdot}375 \text{ kilo.}$$

$$M = 16{\cdot}6 \, \frac{\text{kilo.}}{\text{square millimetre.}}$$

Whilst the carbon filaments not twisted have an absolute tenacity 2·5 times greater than the carbon filament of an Edison lamp, the tenacity of a twisted carbon filament is only 1·7 times as great. This is explained by the circumstance that the twisted fibre is liable not merely to tear, but to break, for which a smaller load is sufficient.

I will here not omit the remark that in determining the modulus of tenacity the time of loading has its influence. A smaller load, maintained for a longer time, tears a wire which had just before resisted a much heavier load. But in comparative experiments, as in this case, it is sufficient to select the time large or small at pleasure. The shot is slowly poured into the scale pan until the filament tears.

For comparison the constants of absolute tenacity of other substances are given as determined by Wertheim.

$$\text{Lead } M = 2 \, \frac{\text{kilo.}}{\text{square millimetre.}}$$

Zinc ...	13	,,
Silver ...	29	,,
Copper...	40	,,
Brass ...	60	,,
Steel ...	80	,,

For wood in the direction of the fibres 8 kilos. per square millimetre is generally given.

After carrying out the above-described experiments on the absolute tenacity of the carbon fibres I felt an interest in determining their density. The experiments to this end were carried out by determining the weight of a carbon filament, its length and thickness. By dividing the weight in grammes by the volume of the filament in cubic centimetres the density was obtained in relation to water = 1.

The following are the densities of—

Edison carbon	1·2
Carbon of my own make	2·1

For comparison the densities of—

Coke	0·40
Hard charcoal	0·47 — 0·57
Pit coal	1·20 — 1·50
Graphite	2·25
Diamond	3·50

Since my carbon has not only a 2·5 times greater absolute tenacity than that of Edison, but nearly double its density, it might be expected that in accordance with the investigations above given, it would better resist the dissipating action of the electric current.

In order to test the accuracy of these conclusions, an Edison lamp of 8 normal candle illuminating power, and an 8-candle lamp of my own construction, were submitted to a severe test. Whilst the illuminating power was simultaneously observed, the current was increased until the carbon filament of the lamp was destroyed. In this test the filament of the Edison lamp gave way at 100 normal candles, the glass globe being strongly blackened. In the lamp of my own make the filament only gave way at 150 normal candles, and the glass globe remained almost entirely clean.

I regarded this as an accident, and repeated the experiment with three lamps of my own make, but always with the same result, the glass globe remaining almost perfectly clean. The rupture of the carbon filaments took place at a luminous power of 130 — 150 normal candles. The four lamps which had undergone this severe test were shown at the Styrian Exhibition.

From these observations I conclude that a dense and tenacious filament becomes soft at a very intense heat, and simply breaks in consequence of existing strains in its texture, whilst a less dense carbon is dissipated, small electric sparks being formed being the several loosened particles. For this view a corroboration may be found in a kindred phenomenon. If the carbon filament is thickly coated electrolytically with copper at one point, but so that the copper is spongy, the latter is almost instantly dissipated on the ignition of the filament.

On the contrary, a much slighter (but more compact) coating of copper is not dissipated, even when the latter begins to fuse.

I have further repeatedly observed that a charred slip of cotton, flexible as felt, is gradually dissipated when it is heated in a vacuum by means of the electric current. Between the loose fibres there are formed sparks, very small, but distinctly visible, in which they are dissipated like the carbon points in an arc lamp.

ELECTRIC LIGHTING AT THE INVENTIONS EXHIBITION.

(*Continued from page 194.*)

THE Andrews lamps are connected up in four branch circuits parallel, two lamps and a resistance of ·6 ohms in each circuit. The lamp employed in lighting the engine shed is of the simplest type for running in parallel circuits. It regulates with great certainty and steadiness, and consists of a long solenoid of fine wire connected up as a shunt to the arc, in which hangs a core suspended by a ribbon passing over a pulley, which can rotate in one direction only to lift the core. When the core descends the ribbon slides over the pulley and acts as a brake; the other end of the ribbon carries a tube, to which the upper carbon is attached; this tube is within another that acts as a guide, and a slot is cut through its whole length to allow of a flexible connection being attached to the carbon-holder tube. The core carries the bottom or negative carbon, and being heavier than the positive holder the carbons are apart, so long as there is no current passing through the solenoid. The moment the current starts the solenoid has great power till it lifts the lower carbon against the upper one and thus short circuits itself, and allows the carbons to part and form an arc. The strength of the current now passing

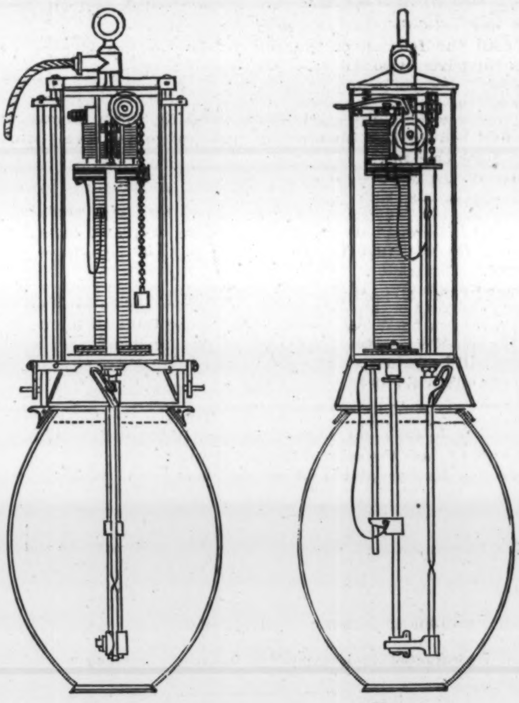


FIG. 1. FIG. 2.

THE ANDREWS LAMP.

through the solenoid depends on the difference of potential of the two carbons, and so long as the difference of potential remains constant, no matter what variation takes place in the quantity of current through the carbons, the solenoid will regulate the arc to the required light. Consequently, the lamp being once adjusted to a fixed electromotive force, the light may be varied from 500 candle-power to 3,000 by increasing the current without any further adjustment. The solenoid has a greater power over the core as the latter enters than when it is within its full length, and as it is necessary this power should be uniform to keep a uniform length of arc as the carbons are consumed, a simple device of a heavy chain passing over a pulley is arranged. One end of the chain is attached to the upper end of the positive carbon-holder tube, and passing over the pulley the other end is attached to a lead weight or number of weights, which are made removable so as to regulate the lamp. Thus, when the core is at its lowest in the strongest part of the solenoid, the chain is balancing part of the weight of the positive carbon-holder tube which is itself a counter-balance to the core. As the core ascends the distribution of the weight of the chains is gradually reversed till the whole weight of the carbon holder tube is balancing part of the core. This lamp is arranged to work in series by the addition of an automatic shunt, placed in the upper portion of the lamp. In addition to the shunt, it is necessary to wind a thick wire solenoid, forming part of the circuit or main wire, over the working fine wire coil. One end of this is connected to the – terminal and the other to a contact on which a spring rests, which joins up this thick wire solenoid direct between the terminals of the lamp. Supposing, now, the current to be started, its power in the solenoid will bring the carbons into close contact, and the current will now also pass through the thick wire on the magnet through the carbons and away. This magnet, by means of the armature, will break the circuit of the thick wire solenoid and allow the carbons to part and form the arc. The lamp now goes on regulating with the fine wire solenoid, the thick wire solenoid being cut out. If the arc should grow extra long or the holder stick through dirt, another magnet, which is wound also with fine wire, opposing the circuit through the outer solenoid, forcibly adjusts the carbons. Another arrangement of this lamp, well adapted to burning parallel, and specially designed to stand rough usage, has the lower carbon holder fixed, and the solenoid is part of the circuit wire. As in the other lamp the chain compensation is necessary, and the ribbon carrying the coil, after passing over the pulley from the core, is attached to a counterweight, and to this also is attached the chain passing over a sheave and carrying a smaller weight at the other end. Now, let us suppose the lamp is ready to be lighted. The carbons will be in contact, the greater part of this weight being carried by the ribbon; when the circuit is completed, the solenoid will lift its core and establish the arc, and the combined influence of the solenoid, the friction of the ribbon and the counterweight will hold the parts in position; as the arc lengthens the solenoid will gradually lose its power, and its core will slide down to compensate for the waste. This lamp is always made in duplicate in the one frame with an automatic shunt to switch in the second, when the first has finished burning, or when the first is being trimmed with fresh carbons.

Messrs. Cordner, Allen and Company, Limited, also make their first appearance this year, lighting the West Central Galleries, containing the American and Russian exhibits, with their "Stanhope" arc lamps, arranged in multiple arc, and supplied by Messrs. Goolden and Trotter's dynamos. The steadiness of the lamps is remarkable, although their construction is more than ordinarily simple. One great advantage which is attached to steady burning is that the carbons are consumed more slowly, and this point must not be lost sight of, as the cost of carbons is one of the chief expenses incidental to an arc installation. These lamps will burn just as well when arranged in series as is requisite on long circuits, but they are placed in multiple arc in the present instance for the express purpose of showing that they may be used in the same low tension circuits as glow lamps, for where both kinds of lamp are employed it is frequently of no slight advantage to be able to use the same dynamo machine.

Messrs. Mather and Platt have in the electric light shed a double cylinder engine and patent "Manchester" dynamo with short belt driving gear. The engine is one of Mather and Platt's double cylinder diagonal engines, with cylinders 8 inches diameter and 10 inches stroke. The bed is specially designed so as to be as rigid as possible, and suitable for an engine running at a high speed. The crank is of the double sweep form, and the crosshead and slides are cylindrical. The engine is fitted with Mather and Platt's well-known patent elastic metallic piston rings. The bearings are made extra long, and the boss of the fly-wheel is extended into the crank bearing, thereby giving a longer bearing to carry the weight of the wheel. The engine is governed most efficiently by an automatic cut-off known as the "straight line" governor. This consists of a weight carried on one end of a lever, of which the fulcrum is a pin on an arm of a wheel keyed to the crank shaft. At the other end of the lever there is a rod connecting it with the eccentric of the valve rod. As the weight moves outwards by the centrifugal force, the lever is rotated about its fulcrum and changes the position of the eccentric on the crank shaft, thus varying the traverse of the valve and consequently the cut off of the steam. A suitable spring is provided for regulating the motion of the lever. The whole mechanism is enclosed in the wheel before mentioned, and is capable of easy adjustment by the regulating spring. The fly-wheel of the engine is 5 feet 6 inches diameter, and drives the dynamo direct by a link leather belt. In order to give the strap more grip on the pulley of the dynamo a very effective arrangement is used. This consists of a swivelling arm which carries at one end a pulley riding loose on a stud. The lower end of the arm is formed into a wheel quadrant gearing into a worm carried on a spindle at the end of the bed of the dynamo. By turning a hand-wheel keyed on the end of the worm spindle, the arm and with it the pulley is raised or lowered, and thus the strap is wrapped more or less round the pulley as required, giving a neat and effective strap driving in a very small space. By this arrangement a long strap is rendered unnecessary, and less strain is put on the driving side of the strap and also on the dynamo shaft, by giving more pulley surface to the belt. The dynamo is placed close under the fly-wheel, so that the entire space occupied is very small. This arrangement will be found illustrated and more fully described in ELECTRICAL REVIEW, February 14th. It is particularly designed for ship lighting, primarily on account of its compactness, but also on account of its ease of adjustment and absolute freedom from noise. The dynamo is of the "Manchester" type, patented by Mather and Platt, and will work 350 20-candle-power lamps, 100 volts, at 1,000 revolutions, the corresponding speed of the engine being 175. The general construction of the dynamo was described and illustrated in ELECTRICAL REVIEW, February 21st. It is compound wound and slightly over compensated, *i.e.*, as the load increases from nothing up to 220 ampères, the electromotive force increases from 100 to 106 volts, thus any slip in the belt or slackening of the engine with the heavy load or resistance of the leads is automatically compensated for. The efficiency of the machine is shown by the following figures:—

Resistance of armature = 0·023 ohms.
„ series coils = 0·012 „
„ shunt coils = 19·36 „

Hence the total electrical horse-power developed is 32·5 H.P. when the E.M.F. is 100 volts, and the machine is working with its full load of 220 ampères.

The loss in the shunt coils is 512 watts = 2·1 per cent.
„ armature and series coils 1,768 watts = 7·3 per cent.
hence the electrical efficiency is 90·6 per cent,

THE ELECTRIC LAUNCH "VOLTA."

MR. A. RECKENZAUN'S newest electric boat the *Volta*, was successfully launched on Monday, at Greenwich Ferry. The "christening" ceremony was performed by Miss A. E. Stephens, daughter of the senior partner of Messrs. Stephens, Smith & Co., engineers, and contractors for the new vessel. This handsome launch will embody all the latest improvements which have been the result of experience with previous electric boats. Her hull, which was built by Mr. Skelton, yacht builder of Millwall, is of galvanised steel, 36 feet long and 7 feet beam, with a depth of 3 feet 6 inches.

With a displacement of 5½ tons she will draw 2 feet 2 inches aft and 1 foot 8 inches forward. There is accommodation for 40 persons on board. The propelling power consists of 70 E.P.S. accumulators, especially made for this purpose to the designs of Mr. A. Reckenzaun. These accumulators are placed below the floor of the boat and serve as ballast, whereby great stability is obtained, which could not be attained by a steamer of similar dimensions.

Two Reckenzaun motors, with their shafts coupled in a line with the screw shaft, serve as engines. This duplex system of driving has been found most successful in the propulsion of tramcars, and it has the advantage of furnishing various speeds and powers without varying the number of cells in circuit, whilst wasteful artificial resistances are at the same time avoided. By a switch with several contacts, the motors can be made to run in series, in multiple arc, or in one alone, whereby 4, 12 or 7 horse-power respectively may be obtained on the screw-shaft, and the boat be propelled at corresponding speeds. Two movable masts and sails are provided in accordance with the specification.

The launching was witnessed by an enthusiastic crowd which cheered whilst the new craft was being towed up the river by another electric launch towards Limehouse, where the machinery will be fitted on board.

Previous to a voyage across the English Channel, the *Volta* will undergo a 40 miles trial trip to which many notabilities will be invited.

THE EXPERIMENTS ON ILLUMINANTS FOR LIGHTHOUSES.

THE Trinity House Committee's report on the experiments made at South Foreland on the relative merits of lighthouse illumination has just been made, and is of great interest. The three experimental lighthouses erected at the South Foreland—one for electricity, one for gas, one for oil—have already been fully described. The effects of the respective lights have been observed not only by eye, but also by photometric apparatus. The distant effects have been measured chiefly by the Elder Brethren afloat, by officers on board light vessels in the vicinity and within range of the lights, by merchant officers in passing ships, sometimes by eye, and sometimes by instruments. Observations were also taken at huts at measured distances, and at the coast-guard and other stations on land. Tabulated statements and analyses of all these observations are given in the report. One or two examples of the observations will form an epitome of the whole series, and for this end are selected the observations on the 17th of May and on the 25th of June. On both days there was thick, dense fog, and the three illuminants were tested under different conditions and very trying circumstances. On the 17th of May the electric light was shown in triform series, that is, three electric lights of equal power superposed in the lantern; the gas in quadriform series, or four sets of lights superposed; and the oil in triform series, three superpositions in the lantern. The electric light continued throughout to exhibit the strongest and most distinct ray, and remained longest visible. The quadriform gas and the triform oil remained pretty closely on a par, but with a perceptible superiority of the latter on the fog becoming denser. The gas was lost sight of at 1,400 feet, the oil at 1,700 feet, and the electric beam at 1,900 feet. All the above were revolving lights, and the oil lights were the ordinary service six-wick burners. On the 24th June the electric light was not shown in triform series, but double power of electric current was sent through one light, thus greatly intensifying its power. Occasionally the current was sent through two lights in biform series. The quadriform gas remained the same as formerly. The fog was very dense, and the electric lights of the permanent lighthouses were not visible. At 700 feet the double-power single electric light was a dim star, barely visible; the quadriform gas (four lights of 88 burners each) was well visible. At 900 feet the observers were doubtful if the electric light was burning; the quadriform gas was indicated by reflection only, as also was the biform seven-ring oil light shown on this occasion. At 1,000 feet all were invisible, only a dull radiance showing the directions of the lights. At 990 feet the biform electric and triform gas were visible; but at 1,005 feet the biform electric was visible, whilst the triform gas had disappeared. At 1,090 feet the biform electric was visible, but the quadriform gas, which had been seen at 1,060 feet, had now disappeared. At 1,200 feet the electric had, like the rest, entirely disappeared. The single double-power electric light, through an annular lens, disappeared at 1,450 feet. The above lights were all revolving.

The general conclusions arrived at by the Committee are that, although so powerful an electric light as was shown in the A tower has never been exhibited in an actual lighthouse, it is, nevertheless, a proved working light, and will be established permanently at St. Catherine's Point, on the Isle of Wight, which, in 1883, was selected for conversion to an electric station. The Committee are of opinion that, for the ordinary requirements of the mariner, its lowest power, or a single current one-lens light is even more than is wanted, but that when in haze, fog and rain its highest powers are put forth, the light will be seen at distances never attempted with gas or oil. As one result the Committee are agreed that there is no necessity for superposing electric lights, as increase of light can be got by increase of electrical current, and that consequently the merits or demerits of this system should be discussed on this basis—one economical advantage being that the expense is avoided of providing more than one set of lenticular apparatus and the additional lamps and fittings necessary for superposed lights. The cost of the electric station is thus brought below that of a gas station, whose chief value lies in the superposition of lights. With the electric system the lantern is clear and healthy, and there is not the undue heat of gas to affect men and apparatus alike. The experiments have shown the quadriform gas light to be a little better than the triform oil; but the difference has been never so marked as to make any practical difference to the sailor.

The Committee sum up their report with these conclusions:—That the electric light as exhibited in the A experimental tower at the South Foreland has proved to be the most powerful light under all conditions of weather, and to have the greatest penetrative power in fog. That for all practical purposes the gas light as exemplified by Mr. Wigham's multiform system in B experimental tower, and the oil light as exemplified by the Trinity House Douglass and wick burners in multiform arrangement up to triform in C experimental tower, when shown through revolving lenses, are equal, light for light, in all conditions of weather; but that quadriform gas is a little better than triform oil. That when shown through fixed lenses, as arranged in the experimental towers, the superiority of the superposed gas light is unquestionable. The larger diameter of the gas flames and the lights being much nearer to each other in the gas lantern give the beam a more compact and intense appearance than that issuing from the more widely separated oil burners. That for lighthouse illumination with gas the Douglass patent gas burners are much more efficient and economical than the Wigham gas burners, and that for the ordinary necessities of lighthouse illumination mineral oil is the most suitable and economical illuminant; and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages.

ELECTRO-MAGNETIC MACHINES FOR LIGHTHOUSES.

M. FELIX LUCAS has just published in the *Annales des pontes et Chaussées*, for July, a long memoir, which, on various grounds, deserves the attention of electricians.

The experimental portion of this memoir gives us very interesting instructions on the conditions of action of magneto-electric machines with alternating currents (the De Meritens system), and never, to our knowledge, have been published so many figures concerning these machines, showing the influence of speed, of external resistance and that of coupling up the bobbins. The theoretical portion is open to criticisms, which, in our opinion, writes M. Hospitalier in *L'Electricien*, deprive it of all value.

The experiments have been conducted at the central service of lighthouses with a De Meritens machine No. 36 G. This machine comprises a fixed inductor formed of 40 U-shaped magnets, and an armature composed of 80 bobbins of copper wire coiled around a core of soft iron. The 80 bobbins are distributed on 5 rings; each of these rings revolves in the interior of a field formed by 8 magnets, and presenting 16 alternate poles. These bobbins form two equal circuits, each comprising 10 groups of 4 bobbins connected in series. We have thus 16 alternations of the current at each revolution.

The two circuits of 40 bobbins may be connected at pleasure either in series or for quantity. We may also let one circuit work alone, either leaving the other open or closing it.

This machine M. Felix Lucas has submitted to experiment, interrogating the machine itself, without dissecting its organs. "The answers," he adds, "have led me directly to the complete equations of the phenomena." Here we are of quite a different opinion. The equations found by M. Lucas, evidently applicable within the experimental limits, do not in any manner present, as he says, the fundamental character of theoretic formulæ, and it would be on the contrary, impossible to obtain them analytically.

We will take, for instance, to fix our ideas, the equation at which M. Lucas arrives to express the intensity of the current as a function of the external resistance of the circuit R, of the connections of the bobbins (μ in series, ν in quantity), and of the number of revolutions of the axle of the armature, per minute, n.

The intensity would have for its expression:—

$$I = \frac{\mu\,(a + \alpha\, n)}{R + \frac{\mu}{\nu}(r + b + \beta\, n)}$$

r being the resistance of an insulated bobbin, a and α coefficients homogeneous to an electromotive force, and b and β coefficients homogeneous to a resistance. This formula may certainly give between 137 and 840 turns per minute (the extreme limits of the experiments of M. Lucas) results in accordance with experiment, but we cannot extrapolate the results of this formula, especially for lower speeds, without arriving at absurd consequences. In fact, when n approaches zero the intensity of the current diminishes and tends towards a finite limit. In the case of $\mu = 8$, $\nu = 10$ this lower limit would be for $R = 0{\cdot}004$ ohm, 49·92 ampères, and for $R = 0{\cdot}120$ ohm, 34·44 ampères.

It would then be impossible, under the conditions of the circuit, to make the machine yield, with the resistances above-mentioned, a current less than 34·44 ampères. This is absolutely contrary to the physical fact.

In a magneto-electric machine with alternating currents closed through a constant resistance, the intensity of the current is a continuous function of the speed of rotation *n*, passing by zero for $n = 0$ and increasing with *n* whilst passing *through all finite values* from zero up to a certain finite value, and asymptote of that which corresponds to an infinite speed.

M. Felix Lucas seeks to palliate this rigorous consequence of his false equation by the following reservations :—

"In reality, if *n* became exactly nil, it is because the machine would be absolutely at rest, and would not give any current; the intensities themselves would be exactly nil. All that it is permissible to conclude from the equations is, that if we make *n* approach zero by slackening the speed of rotation more and more, the intensities approximate respectively towards 49·92 ampères and 34·44 ampères; still the experimental verification of this consequence would be impossible *by means of the electro-dynamometer*, because the successive alternating currents would become too discontinuous. We have remarked that if the value of *n* is merely reduced to 125 revolutions, the indicator of the electro-dynamometer is no longer fixed in an unvarying position; it oscillates to the right and the left of a mean position."

We see that these reservations do not suffice to justify the anomalies of the curve of intensity given by the formula of M. Lucas for low speeds of rotation. The observation concerning the electro-dynamometer indicates simply that special arrangements must be made for measuring currents with slow undulations, or employ a different method.

We have insisted upon this point merely to show that if to obtain a complete and practically useful theory of the De Meritens machine the safest way is not, in the opinion of M. Lucas, that of theoretical considerations, neither is it that which he has chosen.

It needs scarcely be said that since the empirical formula giving the intensity as a function of R, of *n*, and of the ratio $\frac{\mu}{\nu}$ is false, all the formulæ deduced from it are false likewise, as well as all reasonings thence resulting.

But along with these calculations and formulæ there are found experiments the results of which are very interesting and deserve mention, because they precisely confirm the theoretic considerations which enable them to be foreseen without regard to any empirical formulæ.

The figures published by M. Felix Lucas bring into prominence the enormous coefficient of self-induction of the machine. This coefficient acts as a sort of regulator, keeping the intensity within very narrow limits, even for great variations of the external resistance, R, and the speed of rotation, *n*.

Thus, for instance, when the machine is fitted with 8 bobbins in series and 10 in quantity, and that we close the circuit with a very low external resistance ($R = 0·004$ ohm), and if we vary the speed from 137 to 840 turns per minute, the intensity passes from 69·54 ampères to 82·5 ampères, that is to say, increasing only by about ⅙th when the speed of rotation becomes five times greater, whilst it would be quintupled if the coefficient of self-induction were nil.

This relative constancy of the current is the more marked the greater the number of bobbins in series, *i.e.*, the greater itself is the co-efficient of self-induction.

The influence of the variation of resistance of the external circuit acts therefore in a less degree upon the intensity as the coefficient of self-induction and the speed of rotation are greater.

Thus, for instance, if we vary R from 0 ohm to 25 ohms, with 80 bobbins in series and a speed of rotation of 430 turns per minute, the intensity passes from 7·92 ampères to 6·68 ampères.

This is a remarkable constancy and particularly interesting in the application of the De Meritens magneto-electric machines to lighthouses, since it gives a certain elasticity to the action of the regulator, and at the same time, it guarantees the preservation of the machine even if it should be accidentally short circuited. Whatever may be the connection, the intensity in each bobbin cannot exceed 8·23 ampères at the speed of 860 turns.

This property of the De Meritens machine, valuable for lighthouses, is not equally appreciated in the arts, as it indicates a want of elasticity incompatible with industrial requirements.

Another fact made manifest by the experiments of M. Felix Lucas is the following: the maximum value of the work per second which a De Meritens electro-magnetic machine can transform into total or useful electric energy is independent of the connection of the bobbins. It depends merely on the speed of rotation.

At a given speed this maximum power is produced for a certain intensity and a certain external resistance above and below which this power diminishes, but we cannot accept without reservation the figures given by M. F. Lucas, figures deduced from his empirical formulæ and extended far beyond the limits of direct experiment.

These reservations having been made, it would result from the work of M. F. Lucas that the De Meritens machine with 80 bobbins would produce only 2·87 horse-power of disposable electric energy (2,100 watts) at the normal speed of 430 turns per minute and 5·6 horse-power (4,120 watts), at the speed of 860 turns. This is very little for the weight and the size of the machine.

THE CABLE CONTEST.

IN the course of an article on the overtures which have taken place with reference to the possession of the Baltimore and Ohio land lines, the *New York Herald* says :—"It is asked why Mr. Pender, in England, is so anxious to bring about a consolidation between the Western Union and Baltimore and Ohio Telegraph Companies. The explanation lies back of the land telegraph system. It is the Mackay-Bennett cables that cause Mr. Pender and Jay Gould so much anxiety. Mr. Pender, a director in the Western Union Company, is the chairman of the Direct United States Cable Company. The Mackay-Bennett cables in connection with the Baltimore and Ohio land telegraph system have eaten into the earnings of the pool cables of Pender and Jay Gould at the rate of 48 per cent. in six months. The Western Union Gould cable pool is composed of five cable organisations, namely :—The Direct United States Cable Company, the American Telegraph and Cable Company, the Pouyer-Quertier Cable Company, the Anglo-American Cable Company, and the French Duxbury Cable Company. Mr. Pender and Jay Gould, with all these cables and the Western Union Telegraph Company at the back of them, have not been able to compete with the Mackay-Bennett cables. This accounts for their great desire to consolidate, put up rates, and create a new and powerful monopoly on land and sea.

"At the half-yearly general meeting, held in London in July, of Mr. Pender's Direct United States Cable Company, Mr. Pender is reported in the London papers as saying that at the last preceding meeting he had told the directors to be prepared for a reduced dividend; that reduced dividend, he was very sorry to say, had come about. The company was, therefore, in the position of either having to adopt a higher rate or being obliged for a time to make a considerably lower one, because to work at the present tariff with no immediate prospect of increase in the traffic would be unwise. Mr. Pender said, however, that he was hopeful that when those interested in the Mackay-Bennett venture found that the business was so unsatisfactory he could not conceive that they would not be anxious to come to some understanding which would increase their earnings. Having referred to the very great competition now going on between the land lines in America, Mr. Pender went on to show that before a permanent settlement of the submarine system could be made there must be some arrangement come to by the land line companies.

"In this frank but demoralising statement made to his board of directors, Mr. Pender revealed the whole situation. His cable combination was losing money, therefore some arrangement must be 'come to' by the land line companies, which means that the Baltimore and Ohio lines working in connection with the Mackay-Bennett cables are destroying Jay Gould's profits.

"The following condensation of the ocean cable earnings of Mr. Pender's company is derived from the same report. The analysis is interesting to the public if not to the Jay Gould monopoly :—

"*Ocean Cable Earnings for the Half Year ended June 30th*, 1885.

"The half-yearly general meeting of the Direct United States Cable Company was held at Cannon Street Hotel, July 24th, 1885, and the following figures were submitted :—

"Revenue for half year, after deducting out-payments	£36,106
"Working expenses, income tax, &c., but not including cost of repairs ...	17,206
"Leaving a balance of	£18,900

as net profit for half year.

"The revenue showed a decrease of £32,467, as compared with the corresponding period in 1884, being a decrease of 48 per cent., owing to the operation of the reduced tariff, competition, and other causes.

"The stipulated share of cable earnings in the Atlantic cable pool pertaining to the Direct Cable Company was 16⅔ per cent., that of the Western Union Company 22½ per cent. As 16⅔ is to 22½ so is £36,106 to the Western Union share for the half year, say £48,600, or say $250,000.

"The working expenses of the Direct Cable Company, with one cable, amounted for the half year as above to £17,206. The Western Union Company, with two cables, may be supposed to have expended for its working expenses no less than this amount, probably more, exclusive also of repairs. This would leave a balance to the Western Union Company for the half year of about $163,970. Out of this, however, must come the payment for the repairs to the two Gould cables, which were broken during the entire half year, several unsuccessful efforts to repair them having been made in that period.

"Allowing for the payment by the Western Union Company to the American Cable Company of guaranteed interest on the Cable Company's stock, $350,000 for the half year, the above shows an apparent deficit for that period in the operation of these cables of $186,030, without provision having been made for the cost of repairs to broken cables or for sinking or renewal funds. In addition to this, however, the damage to the Western Union revenues in consequence of the competition of the Mackay-Bennett cables is not entirely shown in the cable tolls proper as above, as the Western Union Company, under its contract with the Atlantic Cable Companies, receives for its land line tolls east of New York a fraction over 2c. a word for each word in every message both sent and received.

"A brief calculation will show that the total revenue to the Atlantic cables in the pool for the half year ended June last was in the neighbourhood of $1,300,000, which at 40 cents per word equals 3,250,000 words. Now, as the total cable traffic in the pool fell off 48 per cent. as compared with the year before, it follows that the loss to the Western Union Company on its land line tolls east of New York for the half year at 2 cents per word must have been over $50,000.

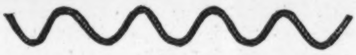
"All the other Atlantic cable companies in the pool have, without exception, set apart each year a sum for renewal of cables equal to say 6 per cent. on the first cost, calculating about 16 years as the life of an ocean cable. For example, the Direct United States Cable Company has on hand a reserve fund for this purpose amounting to £310,000. No provision appears, however, to have been made by the Western Union Company up to this time for such a renewal fund for the two Gould cables, and as they are now four and a-half years old, and have been broken three or four times—having just been repaired after eight months' interruption—the question arises, how will the Western Union Company meet this contingency, and what will the stockholders of the American Cable Company have in the way of actual earning property when the lease to the Western Union Company has expired ?"

ADIE'S PATENT STEEL-TOOTHED BELTING.

THIS belting is being exhibited at the Inventions Exhibition in practical operation by Messrs. Dick, Kerr and Co., a firm well-known by their portable narrow gauge railway. The belt is used in connecting a counter-shaft, driven by a "Griffin" gas engine, with a Pilsen dynamo machine employed to light up their exhibit with some 25 lamps.

The pulley on the dynamo is 6 inches diameter, sufficiently small to test the strength, pliability, temper and toughness of the steel ribbon forming the belt. In this case the metal is 2 inches broad, and double thickness rivetted together ; the section is corrugated.

To ensure a grip between the band and pulley, a ring of the corrugated steel is fastened round the driving surface of the pulley. This gives a firm hold sufficient for all ordinary purposes, but presuming a short circuit should occur through any accident, the elasticity of the material in a wavy or tooth form would allow the belt to ride over the rigger in preference to snapping, as other makes are apt to do when a dynamo is pulled up suddenly.



The Griffin gas engine delivers to the counter-shaft a brake H.P. of three horses, and comparing the result electrically with an Ayrton and Perry ampèremeter, firstly driving the dynamo with a leather strap and again with Adie's steel-toothed belting—the engine being unaltered—the advantage appeared to rest with the latter, in amount about 5 per cent. although the tension erred on the side of slackness, probably causing some slight flapping that took place, together with more noise on the pulley than usually happens. The manufacturers are taking steps to lessen or do away with this objection. Mr. James H. McKean, who is representing the makers, says that among advantages attending the use of this belting, an important and most valuable one is the saving of over half or nearly two-thirds of the power at present employed in all belted machinery. For example : In a machine shop the driving belt must be tight enough to drive all the other belts, and these, in their turn, must be tight enough each to drive its respective machine and take its cut without slipping, whereas, with the steel-toothed belting these two enormous elements of friction are virtually got rid of, the steel belt being loose and acting by the nearly square pull on the teeth at the periphery as it comes off the wheel or rigger. It has, besides, the great merit of cheapness, as it can be sold at twopence per foot per inch wide.

Using it for foot lathes, sewing machines, &c., much leg power can be saved.

In gas engines where the power is limited, this is of much consequence, though, of course, not so important as in large machine shops or mills working by belting, where in all cases the power is more than doubled, or the cost reduced one-half. In a driving belt only, fitted to a 10-H.P. engine, the saving was calculated at 22½ per cent., belt 30 feet long, 3 inches wide, double—cost 30 shillings.

It can be supplied of any strength or width required, and it is said to be capable of doing more than leather belting can possibly do. Along with the belting a stock of rounded corrugated portions to fit each is kept to adapt to smooth riggers. The widths are ½-inch and ¾-inch for lathes, &c., 2-inch treble or 3-inch double for 4½ to 6-inch leather, and so on.

Mr. McKean also mentions that in exhibiting their belting driving a dynamo machine at some 1,300 to 1,500 revolutions a minute, they are not showing their ware to the best possible advantages as regards the general public, but rather placing the belting fairly and openly before the world, by running at a good speed and enabling engineers and others to see at a glance almost all the good qualities, as well as any others that may be inherent to metal straps; and that, whatever slight disadvantages may be found in the belting by persons unaccustomed to its use, will be counteracted by the low price at which it can be obtained—the cost being about half that of leather for transmitting an equal power. The manufacturer and patentee is Mr. Patrick Adie, Broadway Works, Westminster.

LIGHTHOUSE ILLUMINANTS.

IN the REVIEW for Saturday, the 22nd ult., we briefly stated that the result of the recent experiments at the South Foreland established the fact that "for the ordinary necessities of lighthouse illumination, oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

The advantages of the arc light under all conditions of weather appear to have been fully demonstrated; but it is the question of economy which seems to demand some comment. The illuminating power of the naked lights of gas and oil varied from a minimum of 250 to a maximum of 2,500 candle-power, while that of the arc light is given as from 10,000 to 15,000 candle-power. It is not the question of first cost for erecting a station for the illuminants upon which we desire to make a few remarks, but upon the annual maintenance. Both gas and oil give a large volume of light with but moderate intensity, whilst the arc is comparatively only a point of light having very great intensity. The annual maintenance of this latter is considerably in excess of either gas or oil, but we believe that an electric light "the most suitable and economical for the ordinary necessities of lighthouse illumination" can be produced to the utter exclusion of other illuminants. The cost of carbons for a light of 10,000 to 15,000 candle-power must amount to a considerable sum yearly; but we will point out how this could be considerably curtailed.

With the same horse-power as that consumed to produce, say, an arc lamp of 10,000 candle-power, we could obtain, by means of incandescence, a light of one-fifth or one-sixth of that luminosity. A cluster of incandescence lamps would give the extent or volume of light that is obtained from gas or oil, with an equal or superior intensity or penetrating nature. A lamp formed in such a manner would require absolutely no attention whatever; and, if a filament should be destroyed at the end of, say, 1,000 hours, it would cost but little to replace. This suggestion, which we believe has never been made before, is given for what it is worth; but we would ask any of our friends who have more time to devote to the consideration of such subjects than we can spare, to favour us with their views. Gas or oil lamps must involve both trouble and careful manipulation; with such a lantern as that above proposed these considerations would no longer exist. So far as we are aware, no experiments were made at the South Foreland with incandescence electric lighting, and it seems a pity that a lantern made up of, say, 10 lamps of 100 candle-power each, was not tested. The Wigham gas light was used with from 28 to 108 jets, the Douglas with 6 and 10 rings of light, and the oil lamps with 4, 6, and 7 wicks. The report states that the electric light is *absorbed* more largely by haze and fog than either the oil or gas light; this has long been known, but the former seems to have been tested but in one form. Why? The result with respect to the last mentioned kind of weather might then have been quite different.

NEW AMPÈRE AND VOLTMETERS.

THE drawings show an ammeter invented by Mr. Cunynghame and Messrs. Woodhouse and Rawson, consisting of a soft iron armature mounted on an axis between the poles of an electro-magnet and controlled by a spiral spring, the tension of which is measured on a dial by a pointer attached to the spring. When no current is passing and the spring is at rest, and its pointer at zero, the armature rests obliquely across the poles of the magnet, and the pointer attached to the armature also rests at a zero mark. As soon as a current commences to flow the armature is dragged by the magnetic force to a position lengthwise between the poles of the magnet. The spring is now twisted by hand by means of a milled headed screw till the position of the armature is shown by its pointer to be the same as before. Then, since the magnetic force acting on it varies as the square of the current, and is balanced by the tension of the spring, it follows that the tension of the spring is also equivalent to the square of the current. But the tension of the spring depends on the angle through

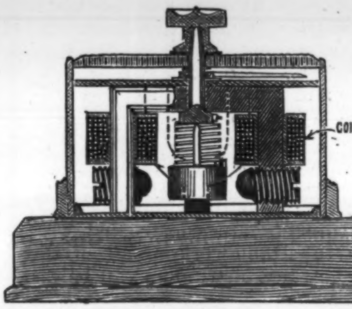


FIG. 1.

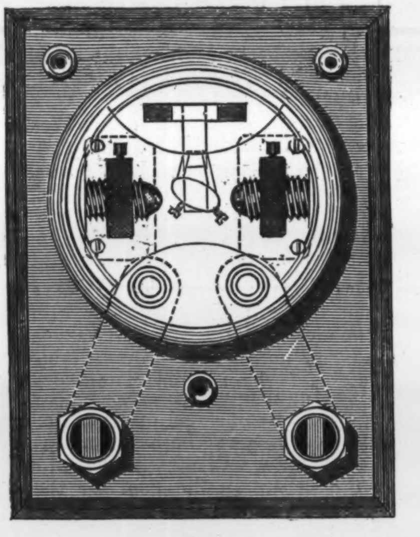


FIG. 2.

which it is dragged, and therefore the square of this angle varies as the current. The dial is therefore divided into divisions representing successive ampères, but which divisions proceed as the squares of the numbers indicated on them, and by means of the movable pole pieces, the magnetic force is easily adjusted to suit the dial.

The instrument is, in fact, a sort of tension balance acting on an iron armature attracted by a magnet. It measures about four inches long by three inches wide, and may be placed either in a horizontal or vertical position.

The advantages claimed for these instruments are as follows: — 1. While possessing the accuracy of a Siemens dynamometer, they are readily portable, having no mercury cups, and may be fixed in *any position.* 2. They do not depend on mercury contacts, so that the current is absolutely unbroken throughout the whole circuit. 3. By reason of the strength of the spring they are almost deadbeat. 4. The horseshoe magnet and armature form together a closed circuit, so that they are not affected by circumjacent magnetic influences. 5. They do not depend on permanent magnets, which are very variable. 6. They read ampères direct on a dial instead of requiring a table of angles and current strengths. 7. They are adjustable by means of the movable pole-pieces, so that the same instrument may be readily set in order with one comparison with a standard instrument and no calibration is required; any instrument can by the like adjustment be made to register currents even double as great as those for which the instrument was constructed.

The instruments are constructed to any required ranges, but the framework of all of them is exactly similar, so that any instrument can be easily altered to suit a different range. By winding the magnets with very thin wire, voltmeters are constructed for which the same advantages are claimed as for the ammeters. These ammeters and voltmeters are also fitted with an alarm apparatus such that when the current or the E.M.F. changes beyond a certain amount a bell rings to warn the attendant.

We have examined and used one of these voltmeters kindly sent to us by Messrs. Woodhouse and Rawson, and if claim 4 can be substantiated, they will doubtless be as much appreciated as the Siemens electro-dynamometer. We are, however, of the opinion that instruments constructed on this or any kindred plan, will not remain constant for any length of time.

NOTES.

The Electric Light in the Royal Navy.—It is now evident that the Admiralty is fully cognisant of the value of the electric light on board vessels in the Royal Navy, and the number of orders given to electrical firms of late is, perhaps, unprecedented. The following vessels, whose description is appended, are now to be supplied by Messrs. Siemens Brothers & Co. with incandescent lights for the purposes of interior illumination, and search lights for fighting purposes:—*Edinburgh*, 9, double screw steel armour-plated turret ship, 9,150 tons, 7,520 H.P.; *Warspite*, 10, steel twin screw armour-plated barbette ship, 7,390 tons, 8,000 H.P.; *Imperieuse*, 10, steel twin screw armour-plated barbette ship, 7,390 tons, 8,000 H.P.; *Collingwood*, 10, double screw steel armour-plated barbette ship, 9,150 tons, 7,000 H.P.; and *Rodney*, 10, double screw steel armour-plated barbette ship, 9,700 tons, 7,500 H.P. In each vessel the current will be supplied by three independent dynamos, each coupled direct to a Willans central-valve compound engine, whose indicated horse-power is about 35, and revolutions per minute, 400. Orders have been received at Sheerness directing the *Pylades*, 14, new composite corvette, 1,420 tons, 1,000 H.P., to be supplied with electric search lights.

Mr. Gladstone and Electricity in Norway.—Whilst at Bergen Mr. Gladstone is said to have been particularly struck by the fact that in a town with a population not exceeding 50,000, there are not fewer than 500 subscribers to the telephone, and that between three and four thousand townspeople have already subscribed to a project for substituting electric lighting for gas in private houses and in the streets.

The Schuyler Electric Light Company.—This company, which is doing a large amount of business in the States, has one of the largest and most completely equipped factories for the manufacture of electrical apparatus in the country. The extensive department where the dynamos are made covers nearly an acre of ground, and is fitted up with the most highly improved machinery. The working force of 175 people is busy filling demands upon the productions of the company. The following plants have recently been installed by the Schuyler Company:—Marlboro', Mass., 60 arc lights; Danbury, Conn., 75; New Britain, Conn., 135; Middletown, Conn., 75; Holyoke, Mass., 150; Kuveville, Tenn., 90; Allentown, Penn., 30; Chicago, Ill., 80.

The same company has secured the contract to light the City of Richmond, Va., for five years, and also the sole and exclusive right to furnish electric light and power of all descriptions to private consumers during the five years. It is expected that under this contract Richmond will be one of the most brilliantly lighted cities in the United States. The plant will consist, first, of 200 arc and 1,000 incandescent lights to supply the order from the city and the subscribers for private lights already obtained, and these will be at an early date increased to meet the expected demand. There were unusual difficulties in the way of securing this contract, inasmuch as the city owned its own gas works.

Frozen Out.—We have recently recorded the adoption of the electric light in Alpine towns. Mr. J. Boyd writes respecting this, saying: "As you refer to Aosta, it may interest you to hear that for many weeks last winter the Dora, which furnishes the driving power for the Aosta dynamos, was frozen so hard that the town was obliged to have recourse to its old oil lamps."

The Lighting at Ashton Court.—In describing the installation carried out at Ashton Court for Sir Greville Smith, it appears that no mention was made of the cables employed. These and the wire generally, we understand, were supplied by Messrs. W. T. Glover and Company.

The Telephone in Kansas City.—The Missouri and Kansas Telephone Company has recently added a seventh multiple switch-board to its plant, bringing up its capacity to 1,400 subscribers. The company has now 1,200, and the number is increasing at the rate of three per day.

Advance of the Telephonic Industry.—The business of the Consolidated Telephone Construction and Maintenance Company in magneto bells and other articles has increased so much of late that the directors have deemed it advisable to order from America some further machinery adapted to their manufacture. The company is now turning out instruments which are of excellent workmanship and finish, and the machinery having arrived from America, a considerably increased out-put is expected.

The Telephone on Railways.—Negotiations, we learn, are in progress between the London and North-Western Railway Company and one of the telephone companies, with the object of connecting the whole of the 2,000 stations on the system of that railway by telephone.

Lancashire and Cheshire Telephone Exchange Company, Limited.—The *Financial News* advises a correspondent to "leave Lancashire and Cheshire telephone shares alone."

The Invention of the Telephone.—The article which we reproduce this week on the Reis telephones is well worth perusal, and we would call special attention to the fact therein mentioned, that in patent law an invention is protected for all possible uses, even for such as never entered the inventor's mind at the time.

West Indian Cables.—Early on Tuesday morning the ss. *Duchess of Marlborough*, one of the repairing vessels of the West India and Panama Telegraph Company, left the river with about 80 miles of deep sea cable on board. This was manufactured by Henley's Telegraph Works Company, of North Woolwich, and is to be used, we understand, chiefly for repairing operations. The tests showed that the electrical properties of the cable, the core of which is of gutta percha, were most excellent.

An Old Cable Scheme Revived.—A contemporary states that the American, British and Continental cable scheme is about to be resuscitated in the form of the International Cable Company.

Cable for the Indian Government.—The cable ships *Dacia* and *International* are now lying in the Thames off the Silvertown factory, taking on board over 500 miles of heavy cable for the Indian Government. This cable, we understand, is under the care of Colonel J. U. Bateman Champain, R.E., who will also go out to the Persian Gulf to take charge personally of the laying operations. The cables in the Persian Gulf at a recent critical period formed the most important connecting link between England and the East, as the ordinary telegraphic route to India and the East was then interrupted, owing to the break-down of the duplicate cables from Aden to Bombay. It is therefore very satisfactory to learn that the Indian Government are fully aware of the services which may again be expected from this new cable, and intend to carry out the work in the best way.

Acts of Bravery by Telegraphists.—Last week it was our pleasing duty to record a brave life-saving feat performed in London by a telegraphist, and that pluck is not exceptional among the fraternity is evident from the following:—As a young telegraph clerk named James M'Cudden was engaged at the General Post Office, Dover, on Saturday night, he saw a militiaman, who was the worse for liquor, and in the company of two comrades, stagger and fall in the dock. M'Cudden instantly left the office, and diving into the water he succeeded in rescuing the drowning man. The occurrence was witnessed by a large number of people, who expressed their admiration of the bravery which M'Cudden had displayed. The young clerk afterwards swam to and assisted in saving another soldier who had jumped in after his comrade, but could not swim.

The Alleged Drowning of a Telegraphist.—We are glad to learn that the statement, copied by us from the local papers, that Mr. Baxter, a telegraphist of Glasgow, performing special duty at Luss, Loch Lomond, was drowned whilst bathing, is incorrect.

Gas Companies and their Customers.—We have been favoured with copies of correspondence which has passed between a gas company in the neighbourhood of London and one of its customers, and which the latter thinks illustrates the harsh treatment generally extended by the metropolitan gas companies to those who are so unfortunate as to be under almost a necessity to make use of their gas. The matter is rather outside our province, and we cannot therefore, as requested, publish the correspondence; but, at the same time, we would express our opinion that the company concerned in this particular matter, as well as other similar corporations, would be well advised to cultivate a little more courtesy in their dealings with their customers.

Sixpenny Telegrams.—The telegraph authorities at Plymouth are making rather elaborate arrangements with the view of meeting the large increase of work which will no doubt be occasioned by the introduction of sixpenny telegrams on the 1st October. The staff is to be increased by 12 hands and eight messengers, making a total post office staff of 233, and no trouble has been spared in making the necessary preparations. It has been decided to entrust the electrical department to the Royal Engineers, and Capt. Bradford, Corporal Le Leux, and a staff of assistants have arrived at Plymouth to make whatever alterations are deemed expedient. A new trunk line will shortly be formed between London and Plymouth, and it is anticipated that the lines between the latter town and Bristol will be duplexed, although this has not been finally decided upon. With the view of increasing the means of communication various circuit alterations will have to be effected.

At Portsmouth it is not proposed at present to add to the existing staff, who will, it is thought, be quite equal to any additional work that may be consequent on the introduction of sixpenny telegrams. If, however, extra hands should be required in order to cope with an emergency assistance could be obtained from the corps of learners attached to the local telegraph offices. It is anticipated that the local effect of the innovation will be to increase the number of messages very considerably, but as the public will soon be taught a lesson in condensation, it is not thought that the actual number of words transmitted will be much larger than heretofore. Various alterations are now being made in the central post office at Landport, giving greater facilities in the telegraphic department.

The Glasgow local arrangements are complete. A large number of new wires have been added to many of the larger towns, while increased facilities have been given to the surrounding districts and suburban offices. To meet all requirements, it is stated that the entire staff of the department, numbering about 450, will be available. Two new seven-wire cables have replaced the old seven and six-wire cables across Loch Long. A new four-wire cable has been laid from Port-in-Cross (Ayrshire) to Corrie (Arran). The wires in this cable serve Islay, Kintyre, and Arran. The old one-wire cable from Arran to Kintyre has been taken up, and a new three-wire cable laid down. The submarine work was done by the cable ship *Monarch* under the superintendence of Mr. D. Lumsden.

The Telegraph Conference.—The Tariff Commission has been concerning itself with a proposal on the part of Switzerland to restrict the commercial cipher code of Europe to 200 words, and, despite the opposition of the English delegate and several of his colleagues, the motion was adopted after considerable discussion; but there is little chance, says the *Times* correspondent, of its being ultimately approved by the plenary Conference.

At a meeting of the Tariff Committee on Monday, a resolution was passed in favour of the abolition of the existing rule that the prices of mutilated telegrams shall be refunded to ther senders. But, as in the case of the proposed restriction of the commercial cypher code, there is not much chance, if the *Times* is to be believed, of this innovation being ultimately approved by the Conference itself.

The *Financial News* thinks it may be questioned whether in the present Conference sufficient weight is given to the preponderating influence which ought to be enjoyed by English telegraph companies. It is hardly too much to say that nine-tenths, certainly five-sixths, of the telegraph cables hitherto laid owe their existence to English capital and enterprise, and under these circumstances it is not pleasant to see English delegates to the Conference occupying a subordinate position. Perhaps English telegraph lines are not too well represented by Mr. Pender and a few Post Office officials. If this be so, they ought to be better represented. Certain it is that English delegates to the Telegraph Conference have been relegated to back seats when they ought to have been called to the most prominent positions.

Risks of Trans-Atlantic Telegraphy.—Following the letter from Mr. R. A. Proctor on this subject, which we published last week, Mr. Robt. Miller Christy has written to the *Times* as follows:—"It appears to me that the blame for the non-delivery of cable messages, as described by Mr. R. A. Proctor in the *Times* of to-day, does not necessarily belong to the cable companies. Probably the fault lies with the American telegraph lines. In the course of last year I had occasion to despatch a large number of inland messages from a great many different places, both in the United States and Canada, and I was astonished at the number of failures that occurred. On several occasions either the message never reached its destination, or I was myself in time to receive it. In cases when I saw the message after its delivery, I found it the exception, rather than the rule, for it to have been transmitted absolutely without error. Transatlantic travellers would do well to remember this."

Awards at the Antwerp Exhibition. — Messrs. Shippey Brothers, electrical engineers, have been awarded both the gold and silver medals for their exhibits at the Antwerp Exhibition.

Solid Electrolytes.—Referring to the letter of Prof. S. P. Thompson in *Nature*, which we published last week, Mr. Shelford Bidwell further writes to our contemporary:—"May I be allowed to say that I too have observed the secondary currents which are produced by cells containing sulphides of silver and copper after being disconnected from a battery? I mentioned the fact at the meeting of the Physical Society on June 27th, in a communication which will probably be printed in the *Phil. Mag.* next month. Indeed, the observation of these secondary currents preceded and led to the construction of the primary cells with solid electrolytes which I have recently described. I should be glad to know whether Prof. Thompson can explain the curious effect produced by passing a battery-current for a moment through a cell containing a mixture of sulphide of copper and sulphur between silver electrodes. When the cell is first connected with the galvanometer the usual secondary current appears, but in a few minutes, or even seconds, this current falls to zero and is succeeded by a third, which is in the same direction as the battery-current, and generally continues for some hours."

A New Electric Motor Company. — The *Financial News* announces that Mr. Montgomery, of Brush Electric Light fame, will shortly bring out a new electric motor company in London.

Edinburgh University.—The *Yorkshire Post* states that the Queen has been graciously pleased to appoint Mr. George Frederick Armstrong, M.A., F.G.S., C.E., some time Professor of Engineering in the M'Gill University, Montreal, and in the Yorkshire College, Leeds, to the Regius Professorship of Engineering in the University of Edinburgh, vacant by the death of Mr. Fleeming Jenkin, LL.D., F.R.S.

The International Inventions Exhibition. — The Executive Council of this exhibition have completed arrangements with the whole of the railway companies of the United Kingdom, whereby parties numbering 25 and upwards can from the present time and until the close of the exhibition, obtain at greatly reduced rates through tickets, combining the journey to London, carriage over the Underground Railways, passage through the South Kensington Subway, and admission to the exhibition, and back. Application for these facilities should be made to any station master in the country.

How He is Appreciated.—The remark with which the *Colonies and India* makes the announcement that Sir Julius Vogel claims £6,000 for services rendered when Agent-General in the conversion of New Zealand stock, will give some idea of the esteem in which this distinguished statesman and financier is held in New Zealand. Our contemporary says: "It was thought that if this demand were granted he would leave the colony, and there was, therefore, a disposition to vote him the amount."

The Siphon Recorder. — Sir William Thomson's patent for his siphon recorder (Patent No. 252 of 1871) has expired this year; and it is probable that the instrument will come into greater use than hitherto. The introduction of permanent magnets for the large electro-magnets originally used to produce the magnetic field of the signal coil will probably be extended, remarks *Engineering*, and there is also a prospect that the troublesome "mouse-mill" will be obviated. At all events, Mr. Pescad, an employé on the Central American cable lines, residing at San Juan del Sur, has invented a plan which reduces the friction between the marking siphon and the front of the paper without the necessity of electrifying the ink by means of the mouse-mill. This plan has been tried successfully for some months on a cable about 1,600 miles long on the Central American coast. The plan consists in vibrating the siphon in such a manner that its point "jumps," as it were, on the paper. This is done by attaching a thread to the fibre which suspends the signal coil about 2 inches above the latter. This thread runs behind the recorder at right angles to the suspending fibre, in a horizontal direction, and is connected to the hammer contact of a small induction coil. When the coil is started by a battery, the vibration of the hammer pulls upon the thread and vibrates the siphon connected to the signal coil, so that the point of the siphon rises and falls on the strip of travelling paper. This movement is, of course, very minute, but it is sufficient to diminish the friction between the siphon point and the moving paper without interrupting the fine ink line which the siphon marks upon the paper. Mr. Pescad states that this line is as good as the line made by the siphon of a recorder with electrified ink. The introduction of this plan, together with permanent magnets, would render the large tray Daniell batteries used with the recorder no longer necessary to its working.

Electric Railway Appliances.—With reference to the application of electricity to the working of railways, the second section of the Railway Conference at Brussels reported that, in view of the great progress which had already been made in this respect, they look forward to further improvements; but they made no recommendation. Eventually, however, the second and third sections consulted together, and reported that considerable progress has been realised in the employment of electricity on railways, and that it is probable that further progress will be made, which will largely augment their security, and that it will be desirable, having regard to this question, to ascertain whether preference should be given to electricity or to mechanical appliances, and that this is a question for the future, having regard to the necessities of distance, climate, and the nature of the apparatus, which can only be decided by experience.

New Cable Ship.—Messrs. Wigham, Richardson & Co., of Newcastle-on-Tyne, launch to-day (Saturday) the screw steamer *Buccaneer*. This ship will be employed as surveying vessel, and as tender to the ss. *Silvertown* during the laying of the West African cables. Besides a complete sounding-gear, this ship is fitted with two cable-tanks and the usual picking-up machinery. She has large bunker capacity, and is engined to steam 13 to 14 knots. The Silvertown Telegraph Company expect to have her off the works by the end of this month.

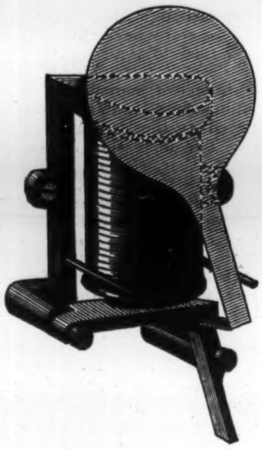
The Mining Exhibition.—The exhibition promoted by the Mining Institute of Scotland was opened at Burnbank, Glasgow, on Tuesday, by Mr. Hamilton of Dalziel, M.P. The grounds are illuminated by four arc lights of 3,000 candle-power each, fitted up by Messrs. Henry Bennett & Co., Glasgow. Messrs. Norman & Son, of Glasgow, have fitted up an installation of incandescent lamps in the lesser hall, and have supplied a dynamo for charging the batteries used for the storage of the electricity required. Messrs. Thomas M'Culloch & Sons, of Kilmarnock, have supplied the engine driving the three dynamos employed in lighting the exhibition buildings and grounds. The Simplex Electric Light and Plant Company, of Eccles, near Manchester, has provided for the illumination of the large hall a dynamo capable of running 200 20 candle-power incandescent lamps, with all fittings, cables and wires, &c. Amongst the exhibitors are Mr. James White, Glasgow, electric bell of special construction, that can be rung through three miles of galvanised wire with one cell of a battery; Messrs. A. Baird & Son, Glasgow, colliery electric bells, Gower-Bell telephone; Messrs. Humber & Fotheringham, Glasgow, electric blasting apparatus, consisting of batteries, cables, fuses; Mr. Lachlan Taylor, Hamilton, magnetic steel castings; Messrs. T. & W. Smith, Newcastle-on-Tyne, copper wire rope lightning conductors; Messrs. Felten & Guilleaume (W. F. Dennis & Co., London), lightning conductors; Messrs. John Mills & Sons, Newcastle-on-Tyne, electric signalling bells and apparatus; Mr. James Brown, Glasgow, electrical apparatus; Messrs. Henry Bennett & Co., Glasgow, electric light apparatus, dynamos, arc lamps, incandescent lamps, switches, electric mining bells and signals, electric bells, indicators, batteries, electric exploders and fuses; Messrs. Robertson & M'Gill, Glasgow, electric bells and material, new electric mining lamp; Mr. John Shaw, Sheffield, lightning conductors, copper cord; Mr. H. M. Edwards, Wakefield, Edwards's improved signal bell, Edwards's electric bells for collieries; Messrs. R. S. Newall & Co., Glasgow, London, and Liverpool, cone consisting of Newall's patent rope and strand copper lightning conductor, copper cords, &c., surmounted by lightning conductor terminals, case containing sections of various telegraph cables manufactured and laid by the company; Simplex Electric Light and Plant Company, Eccles, Müller's patent incandescent lamps, Simplex patent arc lamps, 30-light dynamo machine, switches, safety fuses, electric light fittings, secondary batteries, accumulators; Mr. F. J. Rowan, C.E., Glasgow, drawing of electro-magnetic rivetting machine, Kinetic Engineering Company's electric colliery signal bell, electric bells, pushes and connections, specimens of Berthoud-Borel patent electric cables of high resistance, ampère and voltmeters, electric apparatus; Messrs. Norman and Son, Glasgow, electric lighting, electro-metallurgy.

Electricity in Surveying.—We learn that it is proposed to carry out a trigonometrical survey of the Transvaal, which is to connect with the geodetic surveys of Cape Colony and Natal. The chain of main triangles will extend from Newcastle (Natal) to the Limpopo, keeping close to the 30th meridian, thence it will run south-west along the western boundary of the state to the west side of Griqualand. A chain of triangles will also be run from Middleburg, over Pretoria, to Marico. The longitude of Pretoria will be determined by the electro-telegraphic method. Mr. H. C. Schunke, Government Surveyor of Natal, has been appointed to the direction of this work, by Dr. Gill, the Astronomer Royal at the Cape.

Hammond Contracts.—Notice is given by the liquidators that the Hammond Company's contracts with the Corporation of London, and other contracts in Brighton, Birmingham and Sheffield, as well as the plant at these places, are to be disposed of by tender. The plant, stock and stores, at the company's premises at Finsbury and Bermondsey are announced to be sold by auction, but the date is not yet fixed.

Niagara Falls as Motive Power.—The paper which we publish from the Transactions of the American Society of Civil Engineers contains much interesting matter; although we on this side have not the means to avail ourselves of the information therein given.

Electric Bell Indicator.—Our illustration shows a very simple and efficient form of indicator for electric bells. The armature is pivotted beneath the electro-magnet, and engages with a tooth in the arm of the disc, so that when the armature is attracted the disc is released, and by its own weight falls forward in front of an aperture in the indicator screen in the usual manner. The form is decidedly good, one of the chief points being that no spring is necessary and there is nothing in its action which can be impaired by constant use. The apparatus is manufactured by Mr. E. Thurkle, to whose business extension we had occasion to refer a week or so since.



The Antwerp Exhibition.—Among the English exhibitors of electro-motors at this exhibition we notice the name of Mr. M. Immisch, of the Electric Works, Kentish Town.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Alfred Balstone (Plaintiff) *v.* **The Phœnix Electric Light and Power Company, Limited, George Clerskew** (since deceased), **Edward Arthur Wm. Stephen Garland, Sir Edward E. Meredyth, Bart.** (since deceased), **Richard Revett and John Wm. Cameron** (Defendants).—An order of the Chancery Division of the High Court of Justice, dated 28th July, and filed on the 28th ult., orders that this action stand dismissed out of this Court upon the following terms:—The plaintiff and the defendants, other than the company, to pay their own costs. The contract to take 500 shares in the company to be rescinded. The register of members of the company to be rectified by striking out the name of the plaintiff as a member of the company. The plaintiff to be at liberty to prove against the assets of the company in the winding up thereof, for the sum of £50 paid by the plaintiff in respect of 500 shares, with interest from the date of payment, at the rate of £5 per cent. per annum.

National Telephone Company, Limited.—The annual return of this company, made up to the 21st ult., was filed on the 29th ult. The nominal capital is £600,000, divided into 90,000 ordinary shares of £5 each, and 15,000 preference shares of £10 each. 105,000 shares have been issued, and the full amount has been called thereon. The paid up capital is £600,000, being £455 in excess of the amount recorded in last year's return.

South Eastern (Brush) Electric Light and Power Company, Limited.—The registered office of this company is now situated at 38, Basinghall Street (at the office of Messrs. W. H. Pannell & Co., chartered accountants).

Provincial (Brush) Electric Light and Power Company, Limited.—The registered office of this company is now situated at 38, Basinghall Street.

CITY NOTES, REPORTS, MEETINGS, &c.

The Manchester and District Edison Electric Light Company, Limited.

THE third ordinary general meeting of this company was held in the Memorial Hall, Albert Square, Manchester, on Monday, Mr. V. K. Armitage (chairman of the board of directors), presided.

The Chairman, in moving the adoption of the report and balance-sheet, said that although there had been a loss on the past year's working, there were nevertheless more encouraging circumstances to be referred to than was the case at the last annual meeting. The directors attributed their want of success almost entirely to the absence of commercial prosperity throughout the district. All industries were in a depressed condition, and people were not prepared at the present time to spend money upon the electric light. The depression in electric lighting had followed the depression in other occupations; there was no doubt, therefore, that if there were a renewal of the general prosperity of the district, that company would reap great benefit from it. During the past year there had scarcely been a day in which inquiries with regard to electric lighting had not been addressed to the officers of the company. In about 140 instances estimates had been asked for, and in about 20 cases orders for installations had followed. Those installations had been made at a cost of £5,757, and they supplied 1,530 lamps. In addition, material had been sold in connection with those and former installations of the value of £3,063, making the total turnover £8,800. Out of that they had made a profit of £1,250, or 14½ per cent. upon the turnover. All, therefore, that was wanted now was more business. What business they were doing was done at a decent profit, and the only reason why the balance-sheet showed a loss instead of a profit was found in the fact that their general expenses were necessarily large. If the business could be largely increased the management expenses would not, of course, increase in the same proportion; the result would be a profit at the end of the year. The summer months as a rule had been the dullest period of the year for the company. In former years the company had had absolutely nothing to do during the summer, but since the end of May last work had been begun which represented 1,098 lamps, and a cost of £3,628. The company had also sold £589 worth of material since May, so that during the ten or eleven weeks which had elapsed since then the company had made a profit estimated at £779, which was at the rate of 18½ per cent. on the turnover. From those facts he thought the shareholders might conclude that the tide had turned in favour of the company. The directors were sometimes asked whether there was any likelihood of a further call being made on the shares, which were nominally of the value of £10 each, but on which only £2 had been called up. The board did not intend to call up a single farthing more unless they saw that such additional money could be expended profitably, and unless the shareholders authorised them to make further calls. After looking at all the circumstances attending electric lighting, he considered that the company was in a very favourable position; particularly so when its position was contrasted with that of many others. Arrangements had been made by which the company was about to light the Manchester Art Gallery; the shareholders might therefore look upon the future of electric lighting with great confidence.

Mr. Charles Moseley, in seconding the resolution, dwelt on the importance of the accumulator, and said the one which he had at his residence was working so satisfactorily that he had in one day put in sufficient electricity to last a week.

The report was then adopted, and the meeting terminated.

Great Northern Telegraph Company, Limited.—The interest, due September 1st, on the debentures of 1883, series B, will be paid by Messrs. C. I. Hambro and Son, at 70, Old Broad Street, E.C.

London Platino Brazilian Telegraph Company, Limited.—The half-yearly coupons on the 6 per cent. debentures, due on September 1st, will be paid by Messrs. Glyn, Mills, Currie and Co., 67, Lombard Street, E.C.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of August was 2,832, estimated to produce £2,200, against 2,916 messages, producing £2,515 in the corresponding month of last year. The receipts for the month of May, estimated at £3,700, realised £3,736.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st August, are £2,293, as compared with £2,527 in the corresponding period of 1884. The May receipts, estimated at £7,624, realised £7,641.

The Western and Brazilian Telegraph Company, Limited. The receipts for the weeks ending August 7th and 14th were £1,933 and £1,919, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of August were £1,276, against £1,190 in the corresponding period of last year.

NEW PATENTS—1885.

10122. "Electric meter or current registering instrument." F. F. YEATMAN. Dated August 26.

10126. "Telephone transmitters." R. PRYOR. (Communicated by Miles & Co.) Dated August 26.

10131. "Cut-out device for protecting apparatus or instruments in electrical circuits." H. H. LAKE. (Communicated by D. J. Cartwright.) Dated August 26.

10159. "Application and adaptation of terra cotta for the purposes of electric lighting." J. T. ARMSTRONG. Dated August 27.

10164. "Sandwich boards for advertising by night by means of electric light." E. H. S. BRUCE. Dated August 27.

10180. "Electrical governors." P. W. WILLANS. Dated August 27.

10181. "Galvanic batteries." S. PITT. Dated August 27. (*Complete.*)

10187. "Electrical measuring instruments." E. W. LANCASTER. Dated August 27.

10214. "Electric signalling or call apparatus." C. E. ZIMDARS. Dated August 28.

10231. "Telephonic transmitter." C. D. ABEL. (Communicated by Société Générale de Téléphones.) Dated August 28.

10233. "Microphones in conjunction with the human body." J. J. WALSH. Dated August 29.

10238. "Secondary batteries." W. BEATSON. Dated August 29.

10253. "Electric autographic printing pens." R. E. and E. GEORGE. Dated August 29.

10257. "Apparatus for measuring and registering electric currents." A. G. BROOKES. (Communicated by J. L. Huber.) Dated August 29.

10260. "Dynamo-electric machines." J. S. SELLON. Dated August 29.

10264. "Holdfasts or holders for telegraph posts." R. C. HOPE. Dated August 29.

10304. "Porous plates and cells for galvanic batteries." F. H. VARLEY. Dated August 31.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1884.

12703. "Improvements in electric railways." J. Y. JOHNSON. (Communicated from abroad by E. M. Bentley, of America.) Dated September 23. 8d. Two main conductors extend along the line of railway, but divided into sections or segments shorter than the distance between any two groups of locomotives, which sections, before the starting of any locomotive, are connected by switches, so as to form continuous conductors. When the locomotives are sent out they are divided into multiple arc groups, the last car or locomotive of each group being provided with a projection or circuit opener, adapted to strike fire on the switches, so as to cause them to break the continuity of the conductors with which the locomotives are in constant connection by means of sliding contacts. When a switch has been opened by the projection on a locomotive of one group, it is left open until closed by the leading locomotive of the next group.

12844. "Improvements in telephonic apparatus." D. SINCLAIR. Dated September 26. 6d. The object of this invention is to obtain the advantages of an auxiliary call wire system, with the use of a single wire to serve both for communication directly with the several subscribers, and as a means for communicating with the exchange. This object is attained by connecting each subscriber's wire to the switch board at the exchange, through a polarised indicator of a kind in common use, suspending a vibrating arm of metal connected to the subscribers wire, and insulated from the indicator, between the magnet cores of the indicator, and connecting those cores to the operator's instrument in the exchange.

13067. "Improvements in dynamo-electric and electro-dynamic machines." L. J. GROVES. Dated October 2. 6d. The inventor secures upon the main shaft or spindle of the machine two end cheeks or disks of gunmetal, bronze, or other suitable non-magnetic metal, such disks being formed with holes or slots to receive the ends of bars of bronze or other suitable non-magnetic metal for supporting the armature core, the said bars being parallel to the shaft. The armature core is composed of a number of flat rings formed of thin sheets of soft iron, preferably having between them plies of paper or other thin insulating material. Bars pass through the iron rings, and fit in notches on the inner edges of the rings. Each bar has projections formed or adjustably fixed on it near its ends in positions to confine or bind together the iron rings, the extreme ends of the bars passing through the slots in the bronze end disks, and having nuts screwed on their outer ends if thought desirable. The bronze bars are of tapered section, so as to be thinner at their inner edges to give more room for the passage of the coils of insulated conducting wire, which are wound in the usual way round and through the armature consisting of the combination of iron rings.

13088. "Improvements in telephonic and telegraphic apparatus." C. W. CORBETT and J. L. CORBETT. Dated October 2. 6d. Consists of improved apparatus in connection with branch exchanges of telephonic systems, whereby an operator at the central exchange may place in communication with each other any two subscribers connected to the same branch exchange, or a subscriber on the branch with a subscriber on any other portion of the system. The improved apparatus is also applicable in connection with telegraph lines for enabling the operator at a central office to select out of a series of district stations connected to the same wire, the station to which he wishes to transmit a message; and to place any two stations in direct communication with each other while cutting out the remaining stations.

13698. "Improvements in electrical conductors." T. J. HANDFORD. (Communicated from abroad by E. H. Johnson, of America.) Dated October 16. 6d. Consists in bringing the conductors close together, and so arranging and constructing them that any imperfection of the insulation will immediately establish an arc between the conductors themselves of such low resistance as to amount to a practical short circuit, so that the safety catches will be invariably fused and the circuit broken before damage can occur.

13752. "Improvements in secondary batteries, partly also applicable to primary batteries." G. G. ANDRE. Dated October 17. 4d. Relates to an adaption to secondary batteries of the arrangements described in provisional specification dated 9th January, 1884, number 1,100.

14840. "Improvements in primary batteries." R. A. LEE. Dated November 11. 6d. The object of this invention is the raising and depressing of both the containing cells with the liquid, and also of the zincs and carbons, by means of their specific gravity (without the employment of springs or other counterbalances) especially in regard to the regulation of the speed of electro-motors.

CORRESPONDENCE.

"Risks in Trans-Atlantic Telegraphy."

Seeing a paragraph with this title in your issue of the 29th inst., I think it but fair to give my experience, which extends over twelve years.

I receive from New York regularly three and often four messages a week, and send about an equal number. On an average the mistakes, *i.e.*, words unintelligible, are not one per month. The messages are handed direct to the cable companies in London and in New York. Perhaps this is the reason of such good results. If your correspondent sent his through the Post Office I can understand the errors occurring; but in twelve years we have never had a message fail to reach its destination within a reasonable time.

I have no interest whatever in any of the Atlantic cable companies.

E. H.

The Electric Light in the Law Courts.

The following items regarding the installation here may perhaps be of interest to you, as well as the accompanying table regarding the life of the lamps. The 100 lamps comprised in the all day and engine room circuits are fed by two Mather & Platt dynamos giving 90 volts and 70 ampères at 1,000 revolutions. They are by a considerable amount of alteration of connections connected to a Crompton's collecting switch-board, so that either or both the machines can be switched on or off at will. They are capable of running 200 to 240 lamps if required, and run very nicely, cool and without sparking. By an arrangement of the dividing switch boards, should an odd court or corridor require a light, it can be switched on without starting the main engines, or the all day circuits can be lighted from the main dynamos, and the small engine allowed to stand still. The two Mather-Platt machines are driven by a 10 H.P. vertical engine running at about 165 revolutions. There are about 200 Grundy holders employed in the building, and they have given such thorough satisfaction that all the lamps are to be fitted with them this vacation. There has only been one stoppage in the lighting this year, which was due to water getting on a driving belt through the overflow of a cistern. This was remedied, and all going again inside of two minutes.

Life of Incandescent Lamps at the Royal Courts of Justice from January 10*th*, 1855, *to present Vacation.*

The lamps are Edison-Swan 85 volts 20 nominal C.P. No record was kept of the actual number of hours burnt until the beginning of the present year.

Name of circuit.	Number of lamps on circuit.	Number of hours burning.	Total lamp hours.	Lamps changed.			
				Burnt out.	Broken lugs.	Accidental breakages.	Total.
Courts	446	155 (average)	69,130	15	2	2	19*
Corridors............	159	197	31,323	18	2	3	23
All day circuit ...	56	1,298	72,688	60	1	2	63
Engine room	16	1,298	20,768	27	1	9	37†
New all day circuit	28	480·5	3,454	1‡	—	1	2
Total	705		197,363	121	6	17	144

* Some courts burnt more than others.
† E.M.F. kept at 87 in engine room.
‡ Carbon broke first day.

Average life of lamps burnt out ... 1631·1 hours.
Including losses from all sources ... 1370·43 „

A. Grundy, *Electrician.*

Royal Courts of Justice,
September 1*st*, 1885.

Irish's Transmitter.

Allow me to call your attention to an error in the description of the above-named transmitter in your last week's issue.

You say that a carbon ring is attached to the end of the brass elbow. This ring, however, is made of ebonite or other insulating material, as it stands to sense, were it not so, the microphone would be short circuited. The connection between the carbon projections should, of course, be through the ball only.

N. Macadam.

London, N., *September* 1*st*, 1885.

[Our correspondent is perfectly correct, the word "carbon" should have been written "wooden," we taking the material to be wood.—EDS. ELEC. REV.]

Induction or Leakage.

Allow me to call your attention to an error in your print of my letter of the 24th ult., appearing in your issue of 29th ult. In the third line you have it "*auto* induction cable," this should be "*anti* induction cable."

Your correction would oblige

Arthur Edgar Cotterell.

Indication of Air Bubbles in Cast Iron.

I should be much obliged if you or any of your numerous contributors would kindly tell me, through the medium of your Correspondence column, of any method, electrical or otherwise, by which the position of the small air bubbles or blow holes could be found in a plate of cast-iron half-an-inch in thickness. Could Prof. Hughes's induction balance, or a modification of that instrument, be used for the purpose? Also, is there any book published on the induction balance?

A. G. B.

September 1*st*, 1885.

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Prize Medals, International Electrical Exhibitions, Paris, 1881, London, 1882, and Calcutta, 1883.

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Portsmouth	49, High Street.	Newcastle-on-Tyne	6, Neville Street.
Belfast	22, High Street.	North Shields	Borough Road.

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